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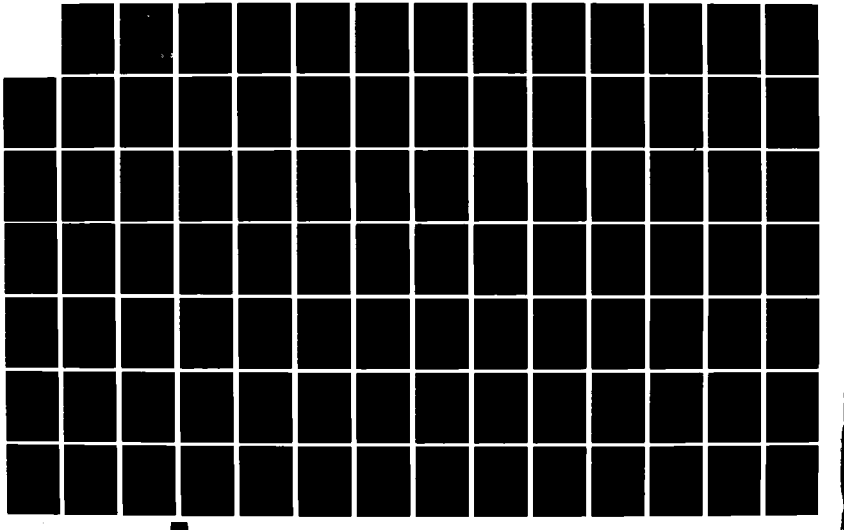

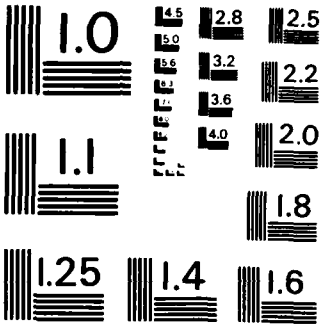

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AVIONICS STANDARDIZATION: PERCEPTIONS AND RECOMMENDATIONS

THESIS

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AFIT/GSM/LSY/85S-11

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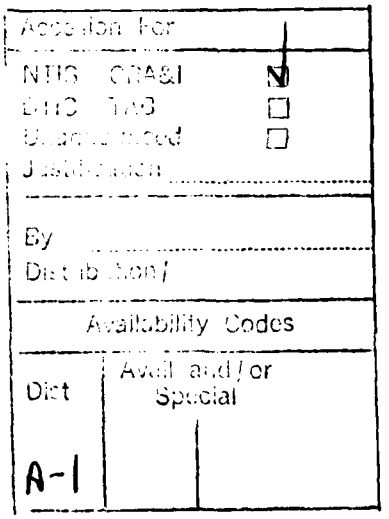

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AVIONICS STANDARDIZATION: PERCEPTIONS AND RECOMMENDATIONS

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Systems Management

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September 1985

Preface

The purpose of this research was to elicit the acquisition community's perceptions and attitudes about avionics standardization. The attitudes of the acquisition community were critical in recommending changes to the current process of acquiring standardized avionics.

In accordance with AFR 800-28, the Deputy for Avionics Control (ASD/AX) is the agency responsible for ensuring that avionics systems are cost-effective and reliable. Part of their mission is to enforce avionics standardization policies and procedures. AX has not been as successful as initially expected in maximizing the standardization potential.

I interviewed 23 people who are currently working or who have worked with avionics standardization. By analyzing the data collected during the interviews, I was able to recommend changes to the current policies and procedures which could help to maximize the potential benefits of standardization.

In doing this research, I have drawn on the knowledge and expertise of other people. A special thanks to all of the interviewees, who took the time and effort to complete the questionnaires and share their opinions with me. I wish to thank AX, and in particular Ken Ricker, Tom Wenzel, and Ed Curry. They gave me the technical and background information which was required for my thesis. I also wish to thank my advisor, Bill Dean, for his continuous encouragement and support of my research. He gave me the insight and

motivation required to get the job done. Last, but not least, I thank my husband, Jeff, who was my proofreader and brainstorming partner. He gave me his love and understanding during my stay at AFIT.

Jennifer A. Furru

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Abstract

This research effort reflects the perceptions and attitudes about avionics standardization by some members of the acquisition community. The data was collected by interviewing 23 people assigned to the Aeronautical Systems Division at Wright-Patterson AFB, Ohio. All of the interviewees were knowledgeable on the subject of and many had extensive experience with, avionics standardization. They either were currently working or had previously worked with avionics standardization.

The analysis reflects some of the attitudes about the policies amd procedures of avionics standardization and the role of the Deputy for Avionics Control in the process of standardization. The analysis also includes recommended changes to the current process of standardizing avionics equipment.

The result of the research effort shows that the acquisition community has not accepted avionics standardization for a number of reasons. First, the level of assembly at which standardization is required, correlates to its acceptability by the acquisition community. The highest level of standardization, the subsystem level, is the most difficult to accept because of the associated integration problems. On the other hand, the lowest level of

standardization, the piece part level, has generally been accepted by everyone. Second, the LCC model currently used by the Deputy for Avionics Control has deficiencies which make it unacceptable, and the model should be revised. Third, the Deputy for Avionics Control has achieved a bad reputation, mostly by their past actions. It's recommended that AX dissolve and become a part of a more respected organization, such as the Deputy for Acquisition Logistics at Wright-Patterson AFB, Ohio. The final recommendations are to give the AX the necessary authority to fulfill their mission and for higher headquarters to strongly endorse the AX's policies and procedures.

AVIONICS STANDARDIZATION: PERCEPTIONS AND RECOMMENDATIONS

I. Introduction

General Issue

The proliferation of spares in the Air Force inventory has prompted an increased awareness of the need for avionics standardization because of the potential savings associated with multiple applications of standard equipment (3:1-1). Avionics standardization has received considerable emphasis as a contributor to reducing support costs (3:2-26).

According to the current industry estimate, the Department of Defense (DoD) will spend more than $50 billion on avionics in the next five years (13:4). The General Accounting Office (GAO) recently published a report on avionics standardization and found that the Joint Services Review Committee (JSRC) estimates a cost avoidance of nearly $770 million in 1983 dollars if the first five standardization candidates it sponsored were developed and installed on military aircraft (13:i). Unfortunately, the JSRC's budget has been cut from $64 million to $21 million since 1980 (13:7). These budget cuts will result in a delay of the planned standardization programs. If the necessary funds are not available, the individual services will continue to procure separate avionics equipment (13:ii).

Current policy on avionics standardization is governed by AFR 800-28, Air Force Policy on Avionics Acquisition and Support, which was first published in 1978. The Deputy for

Avionics Control (ASD/AX) was formed the same year to oversee the policies described in AFR 800-28. This regulation establishes policy and assigns responsibility for acquiring and supporting avionics components, equipment and systems. AFR 800-28 also establishes the need for several key planning documents for integrating the development and support of avionics systems.

The Avionics Master Plan (AMP) is directed by AFR 800-28 and provides guidance to the avionics community, focuses resources on common goals, and presents strategies to move toward the resolution of common problems (3:1-1).

The Avionics Planning Baseline (APB) is an example of a planning document, generated by AX, which contains planning information on each model of aircraft in the Air Force inventory (2:1). The APB shows existing avionics, on-going modifications, other planned avionics, Class IV and V modification funds, and current Required Operational Capability (ROCs), General Operational Requirements (GORs), and Statements of Operational Need (SONs) [3:1-2].

The Armament and Avionics Planning Conference (AAPC) takes place each year and is a forum for discussion of avionics deficiencies, technical issues, and policy issues in the area of avionics and armament (3:1-3). The results of the AAPC are summarized in the Armament and Avionics Planning Guidance (AAPG).

There appears to be a major discrepancy between the established regulations on standardization and the

implementation of these regulations. A thesis entitled Selected Effects of Contractor Reactions to Standardization of Avionics Acquisition led to a recommendation that a greater System Program Office (SPO) awareness was required to effectively implement standardization (1:79). If this is true, then the implication is that standardization has not really been effectively implemented. The underlying management question is, "Has the acquisition community accepted avionics standardization as a way of life?"

Statement of the Problem

The problem of accepting avionics standardization relates to the lack of absolute proof that avionics standardization can reduce the life-cycle cost (LCC) of an aircraft. Most of the standardization studies "estimate" the associated cost savings. Any conclusions drawn are based on certain groundrules and assumptions which must be made. In addition, the LCC model used by AX to persuade the SPOs to incorporate a standardized subsystem has its own limitations. These limitations prevent the LCC model from being totally accepted by the acquisition community as a good argument for standardization.

It also appears that AX does not have the required support from higher headquarters and lacks sufficient authority to enforce the current policies on standardization. The aircraft SPOs are directed in their Program Management Directives (PMDs) to consider standardiza-ion, but the SPOs are not directed by their PMDs to incorporate any specific

standardized equipment into their systems. Therefore, it is left up to the Aeronautical Equipment (AE) SPO to "sell" their standardized subsystems to the aircraft SPOs. This often results in schedule conflicts between the development of the standardized subsystem and the development of the aircraft. Program managers will not incorporate a standardized piece of avionics if their schedule might be affected, since there is no direction in the PMD. These conditions must be corrected if there is to be an improvement in our record of avionics standardization.

Justification

Although there has been a significant effort to establish policies, procedures, and guidelines for avionics standardization, there has been little effort to evaluate the effectiveness of enforcing these policies. The Air Force personnel who work either directly or indirectly with avionics standardization have to believe that avionics standardization is an acceptable way to do business. If they don't, then they will often find ways of avoiding standardization. The easiest way to avoid standardization is to submit waiver requests. This avoidance technique makes AX's job very difficult, especially since they don't have the authority required to enforce the policies and procedures of avionics standardization.

Definitions

The following definitions are used throughout the review.

Avionics.

All the electronic and electromechanical systems and subsystems (hardware and software) installed in an aircraft or attached to it. Avionics systems interact with the crew or other aircraft systems in these functional areas: communications, navigation, weapons delivery, identification, instrumentation, electronic warfare, reconnaissance, flight controls, engine controls, power distribution, and support equipment (1:1-1).

Standardization.

The process by which the Department of Defense achieves the closest practicable cooperation among the services and Defense agencies for the most efficient use of research, development and production resources, and agrees to adopt on the broadest possible basis the use of common, compatible, or interchangeable supplies, components, weapons, or equipment [1:5].

Avionics Interchangeability.

Exchanging one piece of avionics equipment for another without changing the external interfaces on the avionics architecture. This does not imply equipment commonality, but only that the two pieces of equipment are compatible in form, fit, and function [1:1-1].

Avionics Master Plan.

An Air Force plan that integrates all avionics planning, acquisition, modification, and support with mission and functional area planning. The purpose of the plan is to provide cost-effective, time-phased avionics that meets [sic] the needs of present and future aeronautical systems [1:1-1].

Avionics Planning Baseline.

This document has been designed to display all the pertinent avionics planning information available on all Air Force aircraft in the inventory. It is intended to be used as an avionics planning baseline from which information can be derived to assist in effective avionics planning in such areas as developing requirements, instituting or justifying development programs, or establishing modification funding

scenarios or installation schedules [2:1].

Form, Fit and Function (F^3).

> A standard which describes interfaces - mechanical, electrical, and environmental as well as the functions the equipment is to perform, but leaving the internal design and mechanization to the individual vendors (3:2-25).

Scope

This study is limited to the acquisition community's awareness and perception of avionics standardization policies and procedures. The personnel who work directly with avionics systems should know how effective these policies are and what changes can be made to improve the whole process of avionics standardization. Although the problem of standardization encompasses all avionics acquisition within DOD, this study is limited to the Air Force.

Research Objectives

The first step in the research was to determine the process of standardization through a combination of personal interviews and an evaluation of current literature. The next step was to find out what attitudes and perceptions were prevalent among personnel who were experienced in the field of avionics standardization. Were they aware of the current policies regarding avionics standardization? What was their relationship with the Deputy for Avionics Control? These and other questions were necessary to determine the "experts'" level of awareness and are based on their knowledge of current policies and procedures pertaining to avionics

standardization. This interaction with avionics personnel gave the researcher the necessary insight to make recommendations which would improve the effectiveness of the avionics standardization policies and procedures.

Research Question Number One. What is the current process used to identify and obtain standardized avionics equipment?

Research Question Number Two. Are the current policies and procedures being followed?

Research Question Number Three. What is the level of awareness of avionics standardization among the organizations who are involved directly or indirectly with standardization?

Research Question Number Four. What changes to the current procedures for standardization could maximize the potential benefits of procuring standardized equipment?

II. Background

Levels of Standardization

Standardization means different things to different people. Standardization can mean using piece parts from a preferred parts list or using a standardized subsystem on all aircraft in the Air Force inventory. In order to understand the concepts of avionics standardization, a discussion of the various levels of standardization is required.

Piece Part Standardization. The Defense Electronic Supply Center (DESC) maintains a standard preferred list of parts. Generally, if a contractor does not intend to use a "standard" piece part, he must submit a waiver request to DESC. Piece parts standardization has generally been well-accepted by the avionics community (3:3-1).

Modular Standardization. Modular standardization specifies the form, fit and function at the module or card level. The Navy has been using this approach for the past 15 years. "With an existing collection of Standard Electronic Modules (SEMs) that are common across different kinds of functional electronic subsystems, a building block approach to the development of subsystems can be taken [3:3-1]". The Air Force has been reluctant to use this approach because of the associated cost, size, and weight penalties. As the technology of very high speed integrated circuits (VHSIC) matures, the implementation of this approach by the Air Force may become a reality.

Subsystem Standardization. The F^3 approach focuses on

the subsystem and has achieved a high degree of success in the commercial sector. It is much easier in the civilian sector because all aircraft have the same mission, which is to carry people and/or freight. In the military, the missions of the aircraft vary significantly with each of the different types of aircraft developed and these extremes drive the state-of-the-art technology (3:3-2). There is only one avionics subsystem which can truly be called a "standard". That subsystem is the ARC 164 UHF radio. This radio is use on virtually every aircraft in the Air Force industry (7), and it is one of the successful accomplishments of AX. Subsystem standardization requires technical judgment when it is applied to a highly interactive system with complex interfaces (3:3-2).

Policy on Standardization

AFR 800-28 applies to all SPOs in the Air Force who develop, test, modify, or produce avionics equipment (8). The objective of the regulation is "to provide cost-effective, supportable avionics systems that help the Air Force accomplish its mission" (8:2-1). Current policy requires competitive reprocurement, a cost and performance trade-off analysis performed for proposed modifications to avionics systems and HQ USAF approval for deviations from the standards (8:3-2).

Strategic and Tactical Objectives. Chapter two of AFR 800-28 includes the strategic and tactical objectives of avionics. The key tactical objective is

> ... to develop a standard architecture, with the objectives of maximizing the reusing or sharing of avionics systems and minimizing the cost of retrofit. This standard architecture should serve as a basis from which to develop and evaluate future avionics architecture, systems, and subsystems [8:2-1].

The strategic objective which relates to standardization allows the avionics SPOs flexibility in taking advantage of technological innovations but forces them to review all proposals for life-cycle cost and supportability (8:2-1).

HQ USAF Responsibilities. It is the responsibility of HQ USAF to act as the policy-maker for avionics standardization, ensuring that all policies and procedures are consistent (8:4-1). They are also responsible for conducting an annual Air Force Avionics Planning Conference, publishing the Avionics Planning Baseline Document and the Annual Avionics Planning Document, and approving the Avionics Master Plan (8:4-1).

HQ AFSC Responsibilities. AFSC must work closely with AFLC in complying with AFR 800-28. Their tasks include planning avionics development programs and investment strategies, deciding what issues and command positions should be presented at the annual planning conference, and supporting the Deputy for Avionics Control (8:4-1).

HQ AFLC Responsibilities. Jointly with HQ AFSC, HQ AFLC publishes a supplement to AFR 800-28 with specific policies pertaining to their organizations (8:4-2). They must also identify issues and command positions to be resolved at the planning conferences, and plan to use existing and new avionics systems with an emphasis on supportability (8:4-2).

Using and Operating Commands Responsibilities. The using and operating commands must implement the policies and procedures established by HQ USAF, HQ AFSC, and HQ AFLC (8:4-2). They also have the unique responsibility of examining avionics requirements from a functional, rather than an equipment, viewpoint (8:4-1). Similar to the other commands, the using and operating commands must assist in identifying issues and command positions for resolution at the annual Avionics Planning Conference and contribute to the Avionics Master Plan (8:4-1).

Deputy for Avionics Control (AX). AFR 800-28 identifies AX as the single Air Force agency responsible for focusing and controlling Air Force avionics efforts (3:3-6). Their goals are to curb the proliferation of avionics, reduce the life-cycle cost of avionics, and increase avionics availability (3:3-6).

AX actively promotes mature avionics standardization initiatives which offer a savings to the Air Force. The avionics community have generally accepted the following standards as cost savers: MIL-STD-1553B, Aircraft Internal Time Division Command/Response Multiplex Data Bus; MIL-STD-1589C, JOVIAL J-73 Higher Order Language; MIL-STD-1750A, Sixteen-Bit Computer Instruction Set Architecture; and MIL-STD-1760, Aircraft/Store Electrical Interconnection System.

AX provides guidance to the SPOs based on current avionics standardization policies. Life-cyle cost savings are an important aspect of AX's guidance to the SPOs (3:3-

10). The SPOs are responsible for submitting a waiver request when it is not feasible on a technical or life cycle cost basis to apply MIL-STD 1750A or MIL-STD-1589C to their particular program (3:3-6). AFR 800-14, Air Force Policy on Acquisition of Computer Resources, contains waiver policies and procedures for the two regulations mentioned above.

Life-Cycle Cost Model

The Standardization Evaluation Program (STEP) LCC model is the primary tool AX uses to "sell" a standardized subsystem to a SPO (7). The methodology for STEP was developed during a study in 1977 by The Analytic Science Corporation (TASC). TASC initialized STEP in 1978 using the F^3 Inertial Navigation System (INS). In 1980, TASC corrected deficiencies by improving user access and adding capability. The new system was called STEP2. The last enhancement was STEP3, developed in 1984, which expanded I/O capability and added a sensitivity analysis.

STEP differs from other LCC models because it will compute the LCC for a single aircraft type or across the entire fleet of aircraft in the Air Force inventory. It also provides a sensitivity analysis for reliability and unit cost, and determines spare requirements and support equipment requirements.

The LCC programmer must input standard costs. Figure 1 is a summary of the input, processing, and output of the STEP3 model. The standard costs, which must be input, are derived from AFLC Regulation 173-10 which includes labor

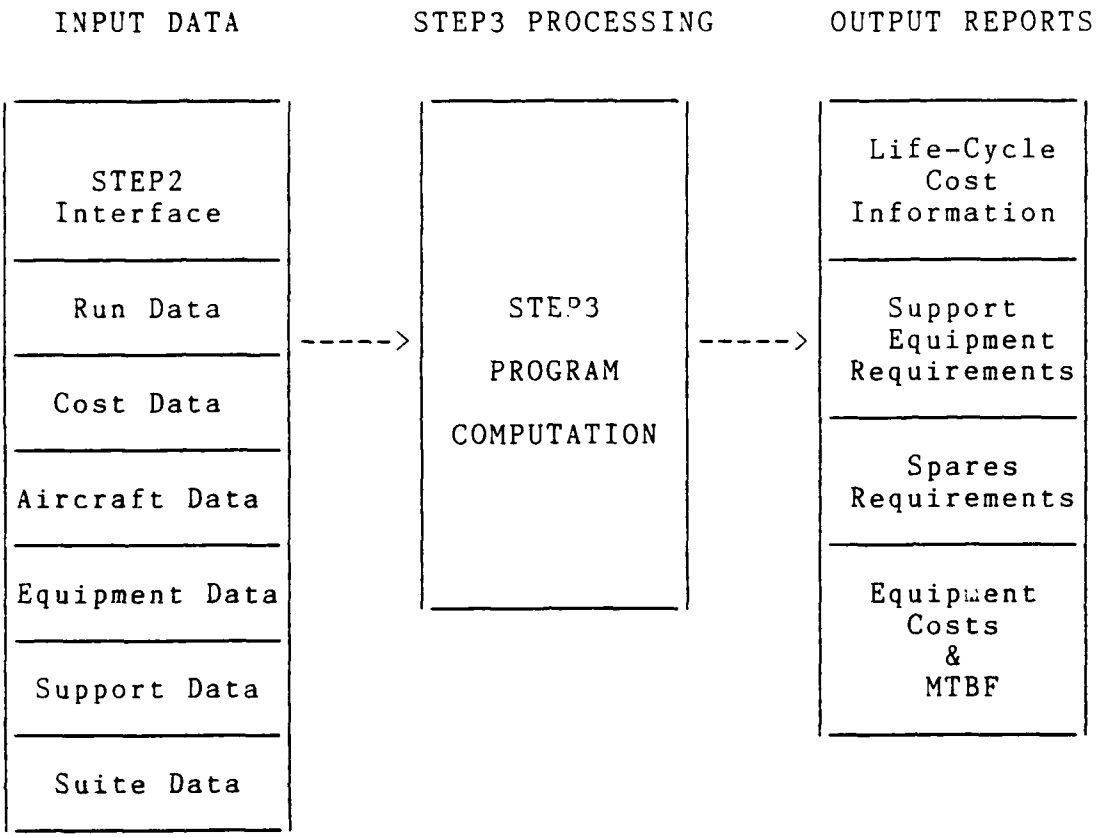

Figure 1. STEP3 overview (4:1-3)

rates, shipping time and shipping rate (7).

One of the limitations of the STEP3 LCC model is that the Line-Replaceable Unit (LRU) development cost is equally divided among the active aircraft which use the LRU in its first year (4:2-10). The cost of support equipment (SE) development is equally divided among the active LRUs which use the SE in its first year (4:2-10). Another limitation

is that the LCC estimator must input the unit cost before the model analyzes the data. Because the main focus of the STEP model is to estimate operation and support (O&S) costs, these limitations are not considered critical. Another limitation is that there is no software estimates associated with the STEP3 model. TASC is currently under contract to correct the deficiencies of STEP3 (7). The new STEP enhancement will include separate hardware and software acquisition modules, and which will integrate with the current STEP3 model. The output of the enhancement will be a hardware LCC, a software LCC, and a system LCC. This enhancement should be complete in approximately three years.

Standardization Criteria

ARINC Research Corporation conducted a study in support of the Air Force Avionics Standardization Program in 1981 (5). The study concluded with some general guidelines for determining the feasibility of standardization. These guidelines are included in the Avionics Master Plan (5:3-3). Table I outlines the four criteria and ranks each criterion for suitability (5:2-28).

These criteria have been generally accepted by the acquisition community. The Technical Director of the Deputy for Avionics Control recently stated that there are two factors at the root of the military standards (12:26). The first factor is that the standards should specify not only how the subsystems interface and function, but also how they should be built (12:26). The second factor is "that the

TABLE I

Criteria for Determining Standardization Potential (3:2-27)

CRITERIA	CATEGORY		
	Least Attractive	Moderately Attractive	Most Attractive
Technological	Performance requirements change frequently; state-of-art pacing equipments.	Functionally similar equipments exist in the inventory. Improvements (primarily packaging, reliability, etc.) are expected.	Previous Standardization precedent exists. Equipment currently exhibits high MTBF.
Architectural	High degree of interconnectivity with other avionics subsystems; moderate or higher degree of software implementation within subsystem.	Low degree of interconnectivity with other avionics systems; moderate or higher degree of software implementation within subsystem.	Low degree of interconnectivity with other avionics subsystem; very low internal software implementation.
Applicability	Used only in aircraft with similar performance characteristics or that operate in identical threat environments.	Used across multiple-aircraft types and in other military services.	Multiple mission and commercial usage.
Economic	Fewer than 2,000 USAF installed requirements indicated before 1992.	Between 2,000 and 4,000 USAF installation requirements indicated before 1992.	Greater than 4,000 USAF installation requirements indicated before 1992.

standards should be vendor-independent in order to promote competition within industry" (12:26). These two factors should be satisfied before proceeding to the set of criteria shown in Table I.

Concerns of the Acquisition Community

The policies on avionics standardization appear to be fairly straightforward. The Deputy for Avionics Control has been designated the "watchdog" for standardization through planning conferences and coordination activities with the avionics SPOs (6). However, some members of the acquisition community have expressed concern about these policies and the effectiveness of the policies in solving the problems of standardization.

Institute for Defense Analysis (IDA) Concerns. In December, 1976, IDA performed a study on the development of avionics subsystems in weapon systems acquisitions. Their study included items which could be used in multiple systems and, therefore, were candidates for standardization. One of the case study findings was that "opportunities for standardization or for the use of standardized equipment are neglected" (14:xix). They also developed the general guidelines for determining when a subsystem should be independently developed and when the subsystem should be standardized. A candidate for standardization must satisfy the following requirements:

1. More than one potential using system (including retrofits) is identifiable.

2. Subsystem technology is mature and well in hand.

3. The potential market is large enough.

4. The projected overall benefits of standardization exceed its disadvantages. If feasible, the cost-benefit analysis should include a life cycle analysis of standardized and nonstandardized equipment.

5. Integration will not be a major problem.

6. The environment of the using system will not adversely affect the performance of the subsystem.

7. Conversely, the environment generated by the subsystem will have no adverse impact on the system or other subsystems [14:47-49].

The study also listed several ways to increase the likelihood that a standardized subsystem will be used. As unbelievable as it sounds, one of the ways is to persuade the program manager "through whatever means are available" to accept the standardized piece of equipment (14:49).

Contractor Concerns. Capt Jeffrey Ackerson and George Baum studied the contractors' position on avionics standardization in 1980 (1). The contractors were concerned with maintaining a competitive environment as an integral part of avionics standardization. They felt that a "sharing of the wealth" among various contractors is more advantageous to them and to the Air Force. On the other hand, proponents of standardization generally feel that standardization promotes competition because it makes the contractors work harder to produce a more reliable and more compatible piece of equipment.

The contractors also recommended that the Air Force promote contractor involvement before the Invitation For Bid

(IFB) or Request For Proposal (RFP) is released (1:79). They want to help the Air Force set the standards. When they are involved post hoc, they have a difficult job integrating the standard subsystems into the system.

Another recommendation by the contractors is to increase the SPOs' awareness of standardization (1:79-80). They feel that the acquisition community does not fully understand the policies and procedures of avionics standardization (1:80).

ARINC Study Concerns. The ARINC Research Corporation's study on the Development of Avionics Installation Interface Standards, completed in 1981, found some ways to avoid over-standardization:

1. Replace standardized avionics only if the replacement equipment has better performance or lower support costs.

2. Structure acquisitions that will benefit both the Government and the contractor and will appease the logistic concern for an over-abundance of spares. The remedy is to let the contractors who have assisted in writing the development specifications make a bid for the production contract.

3. Avoid capricious changes to agreements reached at the open forum discussions on standardization (6:7-2,3).

Survivability vs. Standardization. General Hillman Dickinson (U.S. Army Ret.) is concerned that interservice standardization does not always satisfy the requirements of each service (10:43-44). In time of war, Dickinson states that the survivability of the Air Force depends less on standardization and more on the other needs of the system (10:44). The Army, on the other hand, relies heavily on the interchangeability of communications and automotive equipment

to continue fighting (10:43).

For the Navy, "severe battle damage is much more likely, at least temporarily, to put the entire ship out of operation" (10:44). Therefore, repair equipment must be minimized, which makes standardization an urgent requirement for the Navy.

The Avionics Master Plan characterizes the Navy approach to standardization as a modular approach.

> ... with an existing library of standard electronic modules that are common across many different kinds of functional electronic subsystems, a building block approach to the development of new subsystems can be taken [3:2-26].

Logistic Concerns. The executive committee (EXCOM) in the Armament and Avionics Planning Guidance in 1983 expressed concern that standardization is not improving reliability.

> Two levels of maintenance for fighter aircraft avionics is a promising idea. The most significant factors driving the cost of repair are the Mean Time Between Replacement (MTBR) and the cost of a Line-Replaceable Unit (LRU). If MTBR could be greatly increased or LRU costs greatly reduced, two levels of maitenance [sic] could be cost credible, with current technology efforts such as VHSIC, solid-state active aperture radar, and laser-gyro INU, system reliability could be significantly reduced [sic], making two levels of maintenance cost-effective" [9:iv].

GAO Concerns. The General Accounting Office (GAO) investigated the services' efforts at standardizing avionics systems (13). They attempted to determine the success of standardizing avionics by all Services and the progress of the Joint Services Review Committee (JSRC) in standardizing core avionics subsystems (13:2). The GAO found a lack of high level support for implementing avionics policies

(13:15). They also found that budget cuts delayed the schedule and subsequently forced the program managers to opt for non-standardized equipment (13:11). The study concluded with several recommendations for promoting standardization.

> GAO recommended that OSD direct the Services to: (1) establish a management structure for standardization that includes a high-level sponsor accountable for supporting the JSRC programs through the budget process; (2) determine whether funds for fiscal year 1984 and subsequent years should be reprogrammed to ensure that joint standard avionics systems sponsored by JSRC are developed and available when needed to meet candidate aircraft installation schedules; and (3) establish a dedicated budget line item for joint avionics programs [13:3].

Standard INU Concerns. There have been problems with trying to integrate a standardized subsystem into various aircraft. An example of one such problem is the standard inertial navigation unit (INU), LN-39, which the F-16 SPO has selected for the F-16C/D. The contract was awarded in February of 1983 and is currently in testing. As of February 1985, 40 integration discrepancies were uncovered (11:1). The general categories of these discrepancies are:

1. The LN-39 didn't meet the Standard inertial navigation system (INS) specification.
2. The output parameters were not specified to meet GFE integration requirements.
3. One or both of the contractors misinterpreted specification requirements because the specification was vague and ambiguous [11:1].

As a result of the integration problems, the "out-of-scope" modifications to the contract were estimated to be close to $1.0M (11:2). The original plan was to complete testing within 12 months of contract award. The impact of

the integration problems is that the schedule has slipped and the current estimated completion date is October 1985. The F-16 SPO also anticipates additional problems with integrating other systems such as AMRAAM, AIM-7, and GPS.

Summary

This literature review shows that standardization of avionics is not a clear-cut process. The opinions held about avionics standardization really depend on whether you're a contractor, a SPO, or AX. There have been several studies on avionics standardization. These studies have recommended different (but not altogether dissimilar) guidelines for using a standardized piece of equipment. The STEP3 LCC, used by AX, has certain limitations which might make it unacceptable when presented to a SPO. Budget constraints and schedule delays may adversely affect the acceptance of standardized programs. Lack of high level support is also a factor in the process of standardization.

The decision to accept standardized avionics appears to lie with the avionics program manager. The levels of awareness of program managers are a critical factor in their acceptance or rejection of standardized avionics equipment. The Deputy for Avionics Control cannot force the SPOs to standardize, although they can apply some pressure through the chain of command. Since the SPOs are allocated the funding for their programs, their concerns about avionics standardization should be documented.

III. Methodology

Justification

In order to accomplish the research objectives, it was necessary to talk to the "experts" in the field. These experts are the engineers and managers who work with avionics standardization and who are familiar with the inherent problems of dealing with standardization. The majority of avionics standardization occurs at Wright-Patterson AFB, Ohio. Therefore WPAFB was chosen as the ideal setting for the interviews.

Because the researcher was interested in obtaining the "experts'" perceptions and attitudes about avionics standardization, it was more appropriate to use structured interviews to obtain a sample. Another reason for using the interview method is because the sample of interviewees was taken from organizations within ASD. After the data was analyzed, personnel from HQ AFSC who are involved with avionics standardization were contacted. The conclusions and recommendations were discussed with them.

Sample/Population

The population involved in this research is the Air Force personnel who deal directly or indirectly with avionics standardization. The sample of "experts" was drawn from the following organizations: Deputy for Avionics Control (ASD/AX), Aeronautical Equipment SPO (ASD/AE), F-15 SPO (ASD/TAF), F-16 SPO (ASD/YP), B-1 SPO

(ASD/B1), Strategic Systems SPO (ASD/YY), Deputy for Engineering (ASD/EN), Deputy for Reconnaissance/Strike/Electronic Warfare SPO (ASD/RW), Deputy for Development Planning (ASD/XR), and Flight Dynamics Laboratory (AFWAL/FII).

The list of experts was derived from a list developed with the help of personnel from ASD/AX who were familiar with the population. The list of approximately sixty names was categorized by organization. The desire of the researcher was to get a few people from each of the organizations listed. If someone selected for the interview was not available, another person from that same organization, who was on the list, was interviewed in their place.

Data Collection

A copy of the questions asked during the interviews is listed in Appendix A. The purpose of the interview was to elicit perceptions and attitudes about avionics standardization from the participants in the research, rather than obtaining specific factual information. The questionnaire included the time and date of the interview for identifying and a statement of confidentiality. The questionnaire was divided into six parts. The first seven questions were factual such as job title, length of current assignment, and years of experience. The intent of these questions was to enhance the credibility of the responses of those chosen for interviews.

The next set of questions, a combination of open-ended and informational-type questions related to the role of avionics standardization in the organization of each interviewee. The third part of the questionnaire related to the relationship of the interviewees' organization to ASD/AX. The fourth part was questions on what type of information was available to the interviewees when a standardization decision was made. The fifth set of questions related to the familiarity of those interviewed with specific documents originated by AX and HQ AFSC. The final portion of the questions were intended to determine the respondents' attitudes and opinions about avionics standardization policies and procedures.

Data Collection Plan

The personal interviews took place at Wright-Patterson AFB, Ohio. The interviewees were selected from a list of experts, developed with the assistance of Ken Ricker and Tom Wenzel, both from ASD/AX. In order to prevent inhibition on the part of the interviewees, a tape recorder was not used during the interviews. Additional notes were attached to each questionnaire where additional information was disclosed by the interviewee. After the results of the interviews were analyzed, the researcher disclosed the main findings and recommendations to the Deputy for Avionics Control for their feedback and additional recommendations.

The interviews were scheduled to take place during

May and June 1985. The target was to interview 24 people at Wright-Patterson and 6 additional people from HQ AFSC. The interviews took place in the work environment of those being interviewed. Also, the interviews took place in a private area, where possible, to avoid interruptions.

The researcher estimated that the average interview would last approximately one hour and 15 minutes. To facilitate the interviews, a copy of the questionnaire was distributed at least 24 hours in advance of each scheduled interview. This gave each interviewee the opportunity to review the questions ahead of time.

Analysis Plan

The data was analyzed manually since the researcher felt it was more important to find out perceptions and attitudes about avionics standardization rather than trying to elicit specific responses. Of the 43 questions asked during the structured interviews, 12 of the questions were multiple choice, where the researcher was looking for specific responses. The remaining 31 questions were intended to be thought-provoking and therefore were structured as open-ended questions. After the data was analyzed, the conclusions and recommendations were presented to personnel at AX for their reaction and further recommendations.

Each question was analyzed separately. The responses to each question were first separated into "engineer" responses

derived from AFLC Regulation 173-10 which includes labor

and "manager" responses. The next step was to categorize the responses into five or six groups, if possible. In this way, the researcher could look for trends in the data and determine if there were different trends for the engineers as opposed to the managers.

The data was reported either as percentages or numbers. The term "respondent" refers to the number of people who answered the question. The term "interviewee" refers to the number of people interviewed, which was 23. If an interviewee answered "N/A", the response was counted as "not answered" and was subtracted from the total number of responses for that question.

If an interviewee held a minority opinion, the response was not necessarily discarded. The researcher determined the significance of the response in relationship to the data as a whole. The response was reported if the researcher believed the minority opinion was an important consideration. However, if the response seemed inconsequential and irrelevant, the response was not reported.

Assumptions and Limitations

The first assumption with respect to the selection of the interviewees was that they were well-versed in the area of avionics standardization and that their responses were open and honest. The second assumption was that the potential avionics standardization problems did not have to be proven using statistical methods to have validity.

The primary limitations of the research were time and

sample size, which in turn limited the degree of generalization to the entire population. A secondary limitation was the number of questions asked of those interviewed. The focus of the questionnaire was to elicit perceptions and attitudes from the interviewees about avionics standardization, and to uncover any problems that exist within the process of avionics standardization.

IV. Findings and Analysis

Introduction

The findings of the interviews correspond to the research objectives listed in Chapter 2. First, the demographic data was analyzed to determine the composition of the sample. Then, each research objective was listed and the appropriate responses which correlated to the objectives were analyzed. A summary of the responses is listed in Appendix B. The demographic data (Questions 1-7) has been systematically rearranged to assure the anonymity of the interviewees. The remaining responses (Questions 8-43) are in the exact order in which the information was collected.

All of the personal interviews were completed first. After an initial analysis of the data, the researcher discussed the major findings with personnel from AX. The purpose of this discussion was to elicit feedback about the proposed recommendations.

The personal interviews began on 18 April 1985 and ended on 24 May 1985. In most cases, a copy of the questionnaire was delivered to the interviewee at least 24 hours before the interview, which greatly enhanced the interview. The average length of the interview was 1.5 hours, the longest was 3 hours, and the shortest interview lasted .5 hours.

Sample Composition and Demographic Data

The researcher scheduled personal interviews with 24 personnel located at Wright-Patterson AFB. One interviewee

answered only the demographic portion of the interview questions. The responses given by that interviewee are not included in the analysis.

The sample was selected to include personnel from the major organizations at WPAFB who have experience working either directly or indirectly with avionics standardization. Table II indicates the number of personnel interviewed from each organization. The first seven questions of the interview pertained to demographic data. Of the 23 personnel interviewed, 10 were managers, 11 were engineering managers, 1 was technical manager, and 1 was a functional engineering manager. For purposes of the analysis, the technical manager and the functional engineering manager were grouped with the 11 engineering managers. In those cases where it was important to make a distinction between the responses of the engineers and the responses of the managers, there were 10 managers and 13 engineering managers.

Eight military personnel and 15 civil servants were interviewed. The ranks of the military interviewees ranged from Captain through General Officer. The average rank of the military personnel interviewed was Lieutenant Colonel. All of the civilians were GS-13 or above, and there were 2 SES's interviewed. The average grade of the civilians interviewed was GS-15.

Almost 40 percent of those interviewed had been involved with avionics standardization, directly or indirectly, 10 or more years, another 17 percent of the

TABLE II

Number of Respondents Listed by Organization

F-16	2
B-1	1
F-15	2
Strategic Systems	1
ASD/EN (Engineering)	5
ASD/XR (Development Plans)	2
ASD/RW (Recon/Strike/EW)	3
ASD/AE (Aeronautical Equip.)	3
ASD/AX (Avionics Control)	3
AFWAL/FII (Flight Dynamics Lab)	1
	23

interviewees had been involved 6-10 years, 26 percent had been involved 2-5 years, and 17 percent had been involved for less than 2 years. The implication to the researcher was that the interviewees were knowledgeable and experienced in the area of avionics standardization.

The background of the interviewees varies significantly,

but they all were either working on avionics standardization programs at the time of the interviews, or had worked with them in the past. All of the respondents had worked with at least one avionics standardization program. All but one person interviewed had worked with standardization programs which had reached operational status. This data adds credence to the assumption that the sample interviewed would have an in-depth knowledge about avionics standardization through their past work experience and the programs they were involved with at the time of the interview.

Research Question 1

The first research question is: What perceptions does the acquisition community have about avionics standardization and the *Deputy for Avionics Control*? *An analysis of* questions 8 through 18 of the structured interview questions was necessary to answer this question.

It was not surprising that each interviewee had their own idea of what avionics standardization means (Question 8). Forty-eight percent of those interviewed defined avionics standardization in terms of generalized, low-level requirements for interfaces, instruction sets, software, hardware, and/or in terms of specific line-replaceable units (LRUs). This was the first indication that references to subsystem standardization usually implied negative responses. Twenty-six percent of those interviewed related standardization to the mission of their organization. Eight percent of the interviewees answered that standardization

should be applied "where it makes sense". Seventeen percent of the interviewees defined avionics standardization in negative/neutral terms such as "another factor to consider" and "a noble objective". The responses indicated that avionics standardization was not a clear-cut process in the minds of the people who work with it.

Avionics standardization related differently to the mission of the interviewees (Question 9). Forty percent of those interviewed felt that standardization was a valid consideration and should be applied if and when it makes sense. The researcher got the feeling that these people did not actively search out standards but would consider them if AX recommended the standards and could demonstrate that it made sense to use those standards. The remaining 60 percent felt that avionics standardization was an integral part of their mission.

The one question in the entire interview which required clarification was "Who has performed the detailed review of avionics standardization applications on programs you have worked with?" (Question 12). (The question had seemed straightforward to the researcher.) With two exceptions, all of the engineers agreed that the engineers were the ones who performed the review of avionics standardization programs. However, only 3 of the 13 managers responded that engineers performed the review of avionics standardization programs. The surprise to the researcher was that only 45 percent of the interviewees mentioned AX as a reviewer of standardization

applications. That percentage was reduced to 15 percent if the AX was discounted. This is one of the questions which substantiates the perception that avionics standardization is not a clear-cut process. It also indicates that perhaps AX is not used to the fullest extent possible. There are no guidelines or procedures to ensure that the SPOs apply available standards to their programs. The engineers generally feel it is their responsibility to consider standardization and make recommendations to the program manager, while AX feels it is their responsibility to apply standardization to current programs.

The role of AX in the process of standardization was seen in a similar way by most of those interviewed (Question 13). Thirty-nine percent of those interviewed stated that AX personnel were "policemen" to ensure that programs are standardized. Thirty-five percent of the interviewees looked at AX as an organization that coordinates RFPs, issues waivers, and generates standards. One of the interviewees from AX perceived AX as a helpful organization with the best interests of the program manager in mind. Unfortunately, others didn't always look at AX in that light.

According to the interviewees, AX became involved with their organizations at different times and for different reasons (Question 14). Forty-five percent of the respondents (12 percent engineers and 33 percent managers) said that AX was involved during the review cycle of RFPs, SOWs, specifications and waiver requests. Twenty percent of the

respondents had little contact with AX, 4 percent of the respondents were involved with AX at different times during the acquisition process, and 29 percent of the respondents said that AX became involved at the inception of their programs. The main complaint among the respondents was that AX often becomes involved too late in their programs. Nineteen percent said AX came to them after contract award and asked them to make changes to the program, to include more standardization. These interviewees felt it was unfair of AX to do this. If AX wanted to make changes, it should have been long before contract award. This complaint was brought up throughout the interviews, often as an afterthought to another response and seemed to be a major problem.

The interviewees had different feelings about their relationship with AX (Question 15). Twenty-eight percent of the interviewees responded that they had a fairly good relationship with AX; they cited good personal relationships between the themselves and the personnel of AX as the primary reason. Thirteen percent of the interviewees responded that their relationship with AX was not good; they cited something AX had done in the past which had brought about friction or conflict with their organization. One of them said the relationship was not good because AX became involved too late in programs, another because AX has no "agreeable" life-cycle (LCC) model, and another because of AX's dual command (AFLC/AFSC) status, which allowed AX to take different stands

depending on the situation at hand. Only 1 of the 21 respondents admitted relations were not good as a result of a specific standardization incident which he felt was not handled properly by AX. The remaining 48 percent of the interviewees said they really didn't have much of a relationship, good or bad, with AX.

The question of whether AX has helped or hindered avionics standardization is another area where prior actions by AX have swayed the interviewees one way or another (Question 16). Only 13 percent of the interviewees felt AX had little, if any, effect on avionics standardization. This was either because the interviewee didn't agree with the policies of AX and "won't be pushed around", because the interviewee felt avionics standardization was the responsibility of engineers, or because the interviewee questioned the "goodness" of standardization. Thirty-nine percent of the interviewees felt that AX had helped the cause of standardization, although two of the nine worked in AX. This percentage dropped to 30 percent if the respondents from AX are removed. Twenty-six percent of the interviewees felt that AX had both helped and hindered avionics standardization. They felt that specific incidents, where standardization of a subsystem was forced on an organization, clearly hindered the success of avionics standardization. Thirteen percent of the interviewees felt that AX hindered standardization either because of their attitude about forcing standardization, because they have taken the role of

"crusaders" for the cause, or because AX tries to standardize at the "black box" level rather than at lower levels. These responses indicated to the researcher that the level of standardization had an impact on the interviewees' acceptance or rejection of avionics standardization. The interviewees generally responded favorably about lower-level standardization, such as the interface or instruction set standards. On the other hand, subsystem level standardization was usually referred to in negative terms. This indicated that some of the problems with standardization were effectuated by trying to enforce subsystem standardization on the SPOs.

Forty-eight percent of the interviewees did not include AX in their meetings, conferences, etc. concerning standardization issues (Question 17). The respondents did not invite AX to meetings for various reasons. The most common responses indicate that AX does not have sufficient personnel to attend all of the meetings, that organizations only go to AX when they need them, and that there is a degree of mistrust with AX. Only 26 percent of those interviewed invited AX to most of the meetings and conferences about standardization. Eight percent of the interviewees admitted asking AX to attend some meetings and conferences if these meetings are critical and/or if no "emotional issues" about avionics standardization would be addressed. These responses indicate to the researcher that AX's exclusion during discussion of avionics standardization issues might result in

an insufficient review of standardization applications (See Question 12). Also, excluding AX from meetings might be one of the reasons why AX becomes involved in the programs after contract award.

Forty percent of the respondents felt that AX had sufficient authority to carry out their mission (Question 18), and one of them stated AX didn't have the capability or the manpower to enforce standardization. Another respondent said AX had the authority, but did not take the responsibility. One respondent pointed out that AX didn't have enough control, because it is fairly easy to get a waiver to avoid standardization. One engineer felt that AX has too much authority. He was of the opinion that AX lives in their own little world and should be forced to join the EN engineers so they would understand "the real world". On the other hand, 40 percent of the respondents felt that AX did not have sufficient authority to carry out their mission, for various reasons. One of the primary reasons was lack of support from higher headquarters. Another reason was that their "ineffectiveness is born of their behavior, not their authority". This response again reflects that the attitudes of the respondents are affected by AX's past actions.

The answer to the first research question is that the perceptions about avionics standardization and AX are based on either personal involvement with certain standardization programs or in dealings with specific personnel from AX. The past dealings of AX have been a major factor in the positive

and/or negative feelings about standardization and particularly about ASD/AX. It also appears that the level of standardization determines the degree of acceptability by the interviewees. Subsystem standardization is associated with negative feelings, while architectural standards, e.g. MIL-STD-1553B, generally have been widely accepted.

Research Question 2

The second research question is: How is a potential candidate for standardization selected? To answer this research question, Questions 19 through 26 must first be analyzed.

The initial standardization decisions, according to the respondents, are made anywhere from concept exploration through full-scale development (Question 19). Thirty-three percent of the respondents stated that the initial standardization decisions were made during concept exploration. Another 26 percent of the respondents mentioned that the initial standardization decisions were prior to FSD. Twenty-two percent of the respondents stated that the initial decisions were made during FSD. One of the AX respondents stated that the decisions should be made before the RFP stage. Five percent of the respondents stated that no standardization decisions had been made. Another 5 percent of the respondents stated that all of the standardization decisions were a series of small decisions.

On the other hand, the final standardization decisions aren't, in some cases, taking place until the end of the

program (Question 20). Seventy-nine percent of the respondents stated that the final standardization decisions were made during FSD, or later, and some of the decisions will not be made until the system is turned over to the user. Only 21 percent of the respondents stated that the final standardization decisions were made before the beginning of FSD, and one of those respondents was from AX.

The problem of making standardization decisions at various phases in the life cycle of the program is one of the reasons that AX is perceived in a "bad light" among some of the respondents. Making standardization decisions after contract award has to be costly to the program, and the researcher feels that decisions made before contract award tend to be more beneficial to all concerned.

The information available to the interviewees to support a standardization decision varies to some degree (Question 21). Of the 19 responses to this question, 35 percent stated that all of the following information was available to support their programs' standardization decisions: number of using systems, maturity of subsystem technology, market demand and potential suppliers, projected advantages/ disadvantages of standardization, LCC analysis, problems with integration of subsystem identified, architecture, and cost effectiveness analysis. Only 1 of the respondents said that none of this information was available. He said his organization was told to standardize by AX because "the regulation says to standardize". Fifty-seven percent of the

respondents mentioned that an LCC analysis was available to support the standardization decision. Apparently, an LCC analysis was not requested by the other respondents' organizations. Seventeen percent of the respondents mentioned that problems with integration were identified. This percentage is low considering the fact that subsystem standardization usually has associated integration problems. In general, the respondents had some information to support their standardization decisions.

The next question asked when the information from Question 21 was available (Question 22). Of the 19 people who answered this question, 1 respondent stated that this information was only needed if they were trying to avoid standardization, not if they agreed to standardize. In general, the answers to this question correlated with the responses to Question 20. The information to support a standardization decision was available before the final standardization decisions were made, usually during FSD.

Some of the interviewees suggested other criteria which should be available before a standardization decision is made (Question 23), although 30 percent of the interviewees did not. These criteria include cost (9 percent), risk (8 percent), schedule (4 percent), technology (4 percent), level of standardization (4 percent), function (4 percent), comfort level of SPO director (4 percent), definition of interfaces (4 percent), and supportability (4 percent). One interviewee mentioned a criterion, often overlooked, at the time

standardization decisions are made. That criterion is potential compromise of a standardized subsystem when transferred to a foreign power. He stated that when we have standard items on low-technology weapon systems which we are selling to other countries, we take the chance that the enemy can find a way to jam the standard item and make high-technology systems useless, e.g. ECM. He mentioned this problem again in answering other questions. Although he was the only one who brought this potential problem up during the interviews, his concern is a valid one which the researcher can not dismiss.

Twenty-one percent of the interviewees believed it was the responsibility of AX to select standardization candidates, rather than their organization's (Question 24). If AX doesn't propose using standards, then it is a subjective call on the part of the engineer to recommend candidates, which may or may not be acceptable to the program manager. Thirteen percent of the interviewees mentioned cost-effectiveness as a guideline. If the cost savings don't offset the disadvantages of standardization, program managers will not be amenable to incorporating the standard piece of avionics into their programs. Some of the interviewees felt that AX violates their chain of command to force standardization decisions. This problem complements the question of whether AX has enough authority to carry out their mission (Question 18). Some of the interviewees felt that AX has the authority to enforce standardization. If AX

had the authority to enforce standardization, they should not have to violate anyone's chain of command. It is obvious from the conflicting responses that a clear delineation of AX's authority is absent from the current policies. Thirteen percent stated that if it makes sense to standardize, then use the standard piece of equipment. The remaining answers included offering more than one alternative (4 percent), promoting competition (4 percent), ensuring technical performance (4 percent), and using standards which have broad applications (4 percent). Only 8 percent stated there were no strict guidelines and that standardization should be applied on a case-by-case basis.

According to 57 percent of the interviewees, the guidelines for selecting a standardization candidate differ with each program (Question 25). These responses indicate there are no hard and fast rules applied to avionics standardization. One of the interviewees brought up the point that AX shouldn't come in after contract award, although it had nothing to do with the question. This is another indication that some of the interviewees felt that problems were created when AX tried to incorporate standards after contract award. Seventeen percent of the interviewees stated that the guidelines did not differ. Four percent of the interviewees said to "ask AX", which indicates to the researcher that it is the job of AX to recommend incorporating standards. If AX doesn't make recommendations, then the SPO probably won't standardize.

Eight percent of those interviewed did not recommend any strategies which would increase the likelihood that a developed subsystem would become a "standard" (Question 26). Thirty-six percent of the interviewees mentioned that demonstrated cost-effectiveness and/or commitment on the part of the SPO to use the subsystem would increase the likelihood of a subsystem becoming a "standard". Twenty-six percent of the interviewees mentioned applying lower-level standardization, such as interface standardardization and modular standardization. Other responses include the following: define user requirements early (13 percent), use state-of-the-art technology during the development of the standard (4 percent), define all interfaces early (4 percent), and know what standard equipment exists (4 percent).

The answer to Research Question 2 is that no hard and fast rules are applied for standardizing and the guidelines vary from program to program for selecting a potential standardization candidate. One of the interviewees brought up a potential national security problem if we sell aircraft which have "standards" on board to foreign countries. One of the comments the other interviewees made which corresponds to previous comments is that it is AX's job to recommend standards, but they often try to incorporate those standards after contract award. Another comment was the lack of a valid LCC model for "selling" subsystem standardization. Several interviewees suggested a broader application of lower-level

avionics standardization.

Research Question 3

The third research question is: What is the acquisition community's level of awareness of avionics standardization? To answer this question, the researcher analyzed Questions 27 through 31.

The 58 percent of the respondents who use AFR 800-28 (Question 27) either work in AX (3 respondents), are involved in the JSRC (1 respondent), have required a waiver to avoid standardization (2 respondents), or mentioned the regulation as a guide (1 respondent). Twenty-six percent of the respondents admitted that the regulation contributes "very little" or "nothing" to them in their current positions. Eleven percent of the respondents had no idea what AFR 800-28 contributed to them in their work. Another 5 percent of the respondents admitted they weren't familiar with the document. Of all the documents AX uses, AFR 800-28 was one of the most familiar to the interviewees.

AX spends a significant amount of time ensuring that their documents are current and are revised annually. Forty percent of the respondents knew of the Avionics Master Plan but didn't use it in their work (Question 28), and one of them them said the document was used by higher headquarters only. Another 40 percent of the respondents use the AMP in their work for policy, guidance, and for requesting waivers. Ten percent of the respondents stated that they didn't know

what it was. Another 10 percent of the respondents used it as a reference document.

The questions about the Avionics Planning Baseline Document and the Armament and Avionics Planning Guidance (Questions 29 and 30) were generally answered the same as Question 28, that is, either they were familiar with the documents, or they had never heard of them. There were also those that knew about the documents, but didn't use the documents in their work.

Sixty-three percent of the respondents had no recommended changes to the documents mentioned in Questions 27-30 (Question 31). Another 16 percent believed that the documents were written for higher headquarters rather than for people at the working level. AX believes these documents are intended as guidance to DOD contractors and as a reference source for planned avionics standardization at the working level of ASD. Five percent of the respondents believed that nobody looks at the documents and that "personal contact is more effective". The other responses were that the documents were out of date (5 percent), the SPOs should become familiar with the documents (5 percent), and (an AX response) the documents were improved each year (5 percent).

The researcher believes that AX spends a lot of time in preparing and updating documents for the acquisition community which are essentially not used. Perhaps higher headquarters uses these documents for informational purposes, and industry uses the documents for planning purposes, but

this research indicates they are not used in the normal course of business at the program office level.

Research Question 4

The fourth research question is: What changes can be made to the current policies/procedures to maximize the potential benefits of procuring standardized equipment? To answer this question, the researcher analyzed Questions 33 to 42.

Thirty-nine percent of the interviewees felt there was too little emphasis on avionics standardization (Question 33), 17 percent thought it was about the right amount (including one respondent from AX), and 9 percent thought DOD placed too much of an emphasis on avionics standardization (Question 33. Thirty-five percent of the respondents didn't really answer the question. Of the 35 percent, one of the interviewees mentioned that standardization should only be applied if it made sense. Another interviewee said DOD's emphasis on standardization was wrong because AX doesn't have the capability since their best engineers were hired away. Another interviewee again mentioned the need for a valid LCC model. One of the AX respondents stated that the Air Force lacks in "carrying out those initiatives".

Only one of the 21 respondents admitted being against standardization (Question 34). He did not feel there was "any such thing" as standardization because of all the changes which occur in the subsystem. Three of the respondents gave an unqualified "yes" response. The

remaining interviewees were "for" standardization with varying qualifiers. The management opinions were more performance-oriented, and the cost of standardizing was a major concern. A program manager is not "graded" on the degree of standardization in his program but on how well the system performs and if the system meets the cost objectives. The majority of the engineers were for standardization when it is done right and when it makes sense, but not just for the sake of standardization. One interviewee was for standardization if it was not at the subsystem level, one if it produced logistical benefits, and one engineer was for avionics standardization if it reduced procurement cost.

Eighty-one percent of the 21 people who answered Question 35 stated that the personnel in their organization shared their opinions about standardization. Nine percent of the respondents stated that some people shared their opinions and others didn't. One interviewee from AX said the personnel in his organization didn't share his opinions. This response indicates to the researcher that there may be a diversity of opinions in AX about avionics standardization.

Forty-eight percent of the respondents felt that avionics standardization had been accepted, to some degree, by the acquisition community (Question 36). These people felt that broad standards (e.g. MIL-STD-1589) have been accepted, and that standardization will be accepted where and when it makes sense. This view was evenly divided between managers and engineers. Twenty-four percent of the

respondents felt that standardization has been grudgingly accepted mostly because AX has used force or coercion. Another 28 percent felt that standardization has not been accepted for various reasons. The general feeling is that standardization is just another issue to consider and is accepted if it doesn't cost the program office additional money and if it makes sense.

Over half of those interviewed felt that management/ organizational problems have adversely affected the success of avionics standardization (Question 37). The interviewees mentioned other problems including integration (22 percent), directives/policies (17 percent), funding (13 percent), lack of a valid LCC model (5 percent), and manpower (5 percent) which have affected the success of standardization. One of the interviewees, not from AX, stated that avionics standardization lacks command support which has been mentioned in previous responses.

The next question asked the interviewees the factors which contributed to the success of avionics standardization (Question 38). The responses cover the following general areas: AX involvement, cost-effectiveness of standardization, rational standardization decisions, and previous successful standardization projects. Forty-five percent of the respondents said that the success of avionics standardization was attributable to AX personnel. The respondents used terms like an "aggressive team", "strong personalities", "personal involvement", and "hard-work and

dedication" to describe AX. Three of these respondents also mentioned past support from higher headquarters. Twenty-seven percent of the respondents indicated that demonstrated cost-effectiveness would be a measure of success. (A valid LCC model could predict the cost-effectiveness of potential candidates for avionics standardization.) Another 27 percent of the respondents indicated that avionics standardization decisions where reason and common sense prevailed have been a contributing factor to AX's success. These responses complement many of the responses from Question 34 which indicated that standardization should be applied when it makes sense. Four respondents gave examples of standardization programs which have been successful and which have contributed to the success of avionics standardization. This is a case where AX's past actions have a positive affect on the attitudes of the interviewees.

Question 39 gave the interviewees an opportunity to recommend changes to the current process of avionics standardization. Thirteen percent of the interviewees recommended implementing standardization early in the acquisition phase of the programs. Twenty-six percent of the interviewees recommended policy changes such as "not forcing" standardization, AX operating within the chain of command, allowing major SPOs to build standardized equipment, identifying responsibilities and authorities, and incentivizing the contractor to apply standards. Eight percent of the interviewees recommended changes in management

including new AX leadership, increased ASD/AFSC emphasis, and adequate resources. Twenty-two percent of the interviewees recommended changes to AX. One of them said that AX should operate in a democratic environment, i.e., "after the decision is made, forget about it and go on to other problems". Another interviewee stated that AX's workload should decrease by eliminating duplication of effort, and the personnel should be reassigned. An interviewee from AX wanted to elevate the AX organization to the Air Staff level. This was not mentioned by the other interviewees. Another interviewee wanted to move AX back into the engineering department with commensurate authority. Seventeen percent of those interviewed recommended standardizing at a lower level, such as modules. Some of the other interviewees recommended defining interfaces early in the program to avoid integration problems (5 percent), getting a "useful" LCC model (5 percent), and thinking out the entire acquisition cycle (5 percent).

The responses to the question about the effectiveness of current standardization policies (Question 40) ranged from mostly "no" to mostly "yes". Thirty percent felt that, for the most part, the current policies are ineffective. Another 30 percent felt that the current policies were somewhat effective, and 22 percent felt that the policies were effective. Seventeen percent of the interviewees didn't respond to the question. In general, the respondents felt the policies were ineffective not only because they were

ambiguous, but also because they were not implemented properly. The respondents who answered "yes" gave vague responses such as "it's working", or because AX is "a pain in everybody's side", or because AX has achieved their original objectives.

The responses to the question concerning recommended changes to the current policies/procedures (Question 41) resulted in some of the same responses given in Question 39. Three of the 15 respondents suggested changing the level of standardization from subsystem to modular or piece part standardization. Another 3 respondents recommended changes to the current LCC model which would enhance the arguments to use a standardized piece of equipment. One respondent said AX should continue "as is". Two of the respondents recommended giving program managers incentives to incorporate "standards", and another recommended incentivizing the contractor to recommend standards. One respondent said that higher headquarters should put the direction in the PMDs of the SPOs to incorporate the "standards" into their programs. One of the respondents recommended training AX on the problems of the SPO. Another respondent didn't want to give AX any more authority than they already have because "it would make things worse". Another respondent recommended letting the SPOs prove it isn't feasible to incorporate a standard piece of equipment; this would eliminate the need for AX to "sell" the standard equipment to the SPOs. The responses to this question reiterate some of the

recommendations made previously which include a lower level of standardization and a revision to the current LCC model. These and the other recommendations are feasible solutions to the acquisition community's acceptance of avionics standardization.

Question 42 asked the interviewees to select one or more strategies which could increase the likelihood that a developed subsystem would be standardized. The list included the following: a) Mandate the use of the subsystem through the contract or through rulings of the Secretary of Defense; b) Persuade the program manager to accept the subsystem; c) Provide economic incentives to the contractor to use the developed subsystem; d) Reduce the level of system optimization and performance extremes (design to cost); e) Emphasize reliability and maintainability, development cost, and low risk in the system specification. Question 42 was similar to Question 26 except that in Question 26 the interviewees were not given a list of strategies to choose from. The engineers most often chose the strategies "to emphasize reliability and maintainability", "design to cost", and "to persuade the program manager". Sixty-nine percent of the engineers chose at least one of these options. Eighty percent of the managers selected the strategy either to "persuade the program manager" and/or to "provide incentives to the contractor".

The last question of the interview asked the interviewees to recommend a way to ensure implementation of

the one or more strategies they selected in Question 42 (Question 43). Fifty percent of the managers and 46 percent of the engineers believed that the program manager could be persuaded to accept the standardized equipment through various means, that is, by a LCC analysis, proof of improved reliability, and/or by putting direction in the program manager's PMD.

The data indicates to the researcher that avionics standardization has not been accepted by the acquisition community. This lack of acceptance prevents the effective maximization of avionics standardization applications. The ambiguity of the policies, AX's apparent lack of authority to enforce avionics standardization (especially at the subsystem level), and the SPOs reluctance to accept standardized subsystems makes the situation very confusing. Add to this the bad reputation AX has acquired from its past actions and there is little doubt that changes must be made if avionics standardization is to be accepted by members of the acquisition community, and especially program managers who control the standardization decisions made on their programs.

V. Conclusions and Recommendations

Conclusions From the Research

Avionics standardization can potentially improve reliability, maintainability, and supportability. Avionics standardization can also be a cost-effective alternative to the soaring cost of uniquely developed avionics systems and subsystems. The data collected from the interviews indicates some problem areas which prevent avionics standardization from being totally accepted by the acquisition community. The data also indicates that the process of avionics standardization is not a clear-cut process. The existing problems must be solved before avionics standardization becomes an acceptable way to do business for the Air Force.

Appropriate Level of Avionics Standardization. The acquisition community must be able to agree on the appropriate level of standardization. The engineers interviewed generally agreed that avionics equipment standardization should be accomplished at a level below subsystem standardization. Standardizing at the "black box" level has sometimes caused integration problems for the program office. It is very difficult to integrate the same standardized subsystem into various aircraft which have different subsystems and different missions. If the "black box" is still in the development phase, program managers are likely to defer accepting and incorporating the subsystem into their programs because of the additional risk associated

with the standardized item. On the other hand, the piece-part standards, interface standards, electrical and electronic bus standards, software instruction set standards, etc. have generally been accepted by the acquisition community. Several engineers recommended modules as the highest level of standardization. The modular approach to avionics standardization has been used by the Navy for the past 15 years and has been very effective (See Chapter 2). However, if this is implemented, the SPOs which develop and produce standardized subsystems would become extinct. It is apparent from the interviews that the policies and procedures are unclear about the appropriate level of standardization.

The Perceptions About AX. When the concept of an avionics standardization organization first came about, it was endorsed and supported by General Slay, then Commander of AFSC. The mission of AX is to reduce cost and improve reliability and maintainability through standardization, as outlined in AFR 800-28. Many interviewees felt that AX had been fairly successful in educating the acquisition community about avionics standardization. However, several interviewees felt that AX forces standardization on the acquisition community for the sake of implementing available standards rather than incorporating standards because it makes sense to do so.

A significant number of interviewees complained that AX doesn't have a valid Life-Cyle Cost (LCC) model which demonstrates to the acquisition community that money can be

saved on their programs by the use of standard equipment. These interviewees maintained that, if there is no valid LCC model, then AX can't prove to them that standardization is cost-effective.

A number of those interviewed felt that AX didn't get involved early enough in the programs to allow the standardization issues to be resolved before contract award. However, it can be very disruptive to the program when AX becomes involved after contract award and wants standardized equipment incorporated into the programs. Incorporating standards after contract award can be costly, can cause a schedule slip in the program, and may adversely affect the performance of the aircraft. Until the program manager is "graded" on factors other than cost, schedule, and performance, there is little incentive for the program manager to adopt the proposed standardization.

Some interviewees felt that AX was not involved in meetings and conferences early enough in the program. This is attributed to a lack of sufficient manpower in AX and/or to specific exclusion of AX personnel because of their past actions. The ideal time for AX to become involved with the SPOs is during the conceptual phase of the program when they can monitor the use of "standards" in the lab. When AX is not involved during the conceptual/demonstration validation phase of the acquisition cycle, it is likely that AX will try to incorporate standards later in the program. If later they are prevented from giving input to the Request

for Proposal (RFP) and to evaluate the contractors' proposals for the use of standards, then they will probably try to make changes after contract award. changes to the contract, after contract award. If the acquisition community doesn't want this to happen, then they must get AX involved early in their programs.

AX's Authority. As outlined in AFR 800-28, AX is responsible for focusing and controlling Air Force avionics efforts. AX does not believe they have sufficient authority since they must occasionally rely on their chain of command to achieve their avionics standardization objectives. However, almost half of those interviewed believed that AX does have sufficient authority to carry out its mission because they sometimes violate the chain of command of their organization. Program managers believe it is unfair that AX violates the program manager's chain of command to carry out their mission. Going up to HQ AFSC and/or HQ AFLC for general officer direction to the program manager in the SPO breaks down the communcation and cooperation and usually makes an adversary of the program manager. It is doubtful that AX will ever get full cooperation from that program manager when it comes to resolving standardization issues.

Higher Headquarters Support. When General Slay was the Commander of HQ AFSC, he had a sincere interest in standardizing avionics programs. Since he has retired, there hasn't been strong advocacy for avionics standardization at the command level. There is still high level support of the

JSRC which identifies and supports inter-service avionics standardization projects; higher headquarters makes the standardization decisions for the JSRC-sponsored projects. However, the data from the research indicates that the standardization decisions on all Air Force projects are currently being made at ASD with minimal high-level support and guidance.

Many engineers believe that they are trying to incorporate standards into programs when it makes sense to standardize. This works well if the program manager agrees. The program manager may or may not accept the recommendations made by the engineer working on the program. Higher headquarters does not currently "grade" program managers on how many standards are incorporated into their program. Therefore, program managers aren't compelled to standardize unless it can be shown that standardization will not adversely affect the schedule, the performance, or the costs of developing, producing, and operating their systems. Without significant high-level support, AX must resolve avionics standardization issues that alienate the program manager.

Recommendations From the Research

The Air Force should make some significant changes to the current process of avionics standardization to reduce the cost of avionics and maximize the effectiveness of standardization. These changes would affect the acquisition community, AX, the standardization documents, and most

importantly, higher headquarters.

The first recommendation is that higher headquarters must support and endorse AX and the policies/procedures of avionics standardization. Without their support, the subsequent recommendations cannot be effectively implemented. The most significant way for higher headquarters to support avionics standardization is to ensure that the program offices have specific direction in their PMDs to incorporate proven standard subsystems. By having specific direction to apply avionics standardization, the program manager can then justify schedule slips and cost impacts which directly relate to the incoporation of the standard equipment in his or her program. The PMDs should also make reference to the broader standards such as MIL-STD-1750 and MIL-STD-1553B.

The second recommendation is a complete revision of the Deputy for Avionics Control. They have accomplished a lot in their years of existence, but they have made some mistakes along the way. In most cases, the animosity toward avionics standardization felt by the acquisition community is attributed to the past actions of AX. In order for AX to really change their image, the organization known as AX should be dissolved, and the personnel in AX should be moved to another organization. They could become a part of ASD/AL, or AFSC/AL, because AL has a good reputation and the acquisition community thinks well of them. The mission of AX and their functions would not change significantly.

Part of this reorganization would entail a revision of

AFR 800-28. The regulation, as it stands, gives AX all of the responsibility for, and little authority to, maximize avionics standardization. It should reflect tougher constraints on waivers. The revision should also include a definition of avionics standardization, the identification of preferred levels of standardization, and a schedule of required standardization reviews to be accomplished before the draft RFPs are released.

Many potential problems can be avoided if it is clearly understood by everyone that standardization must be looked at during the conceptual phase of the acquisition cycle. This includes standardization applications in the lab. If the laboratories don't incorporate standardized equipment into their program, it diminishes the likelihood of standard equipment being incorporated at a later time. AX must be allowed to attend meetings and conferences which involved standardization issues. However, if it is not done, AX should be allowed to make changes to a program to realistically apply avionics standardization.

The final recommendation is to revise the LCC model currently used in applications of standardization. Much of the concern with using standardized equipment relates to potential additional costs incurred by the program office when standardized equipment is incorporated. The revised LCC model should be coordinated by all organizations which use standardized equipment before it is finalized. An LCC analysis, using this model, should be accomplished for all

standard avionics subsystems which might be applicable to a program. The LCC analysis should also be available during the early stages of the program before, not after, the standardization decisions are made.

Recommendations for Further Research

This research has been limited to avionics standardization at ASD. The problems which exist at ASD are probably worse at other bases where avionics equipment is developed and acquired. At Space Division (SD) and Electronic Systems Division (ESD), it's not possible for AX to review and coordinate on all RFPs and SOWs before they are approved, even though AX has that responsibility. Further research should be done at these bases to assess the successes and/or failures.

Another area which requires further research is the cost-savings factor of avionics standardization. A study should be done of systems which have incorporated standards to verify that avionics standardization is actually cost-effective to the program. Some people are not convinced that standardization can save money. The STEP3 model, used by AX, should be validated to demonstrate that the assumptions and ground rules used in developing the model are realistic. Several avionics standardization projects which were undertaken after being analyzed with the STEP3 LCC model could be candidates for further research. The LCC analysis on these programs could be compared with the actual costs of developing and producing them. This comparison could

prove that the model is acceptable, or it could identify some of the deficiencies with STEP3 which require correction.

Another area which should be investigated is the impact of avionics standardization on national security. There is a possibility of compromise as a result of applying avionics standardization to both weapons systems which can be transferred/sold to a foreign power and weapon systems which are critical to national security. If the enemy could find a way to jam the standard subsystem from the exported system, he may be able to jam the security critical system and reduce its mission capability. In this instance, the decision to standardize the subsystem in the security critical system would not be advantageous to the Air Force. There may be other instances where avionics standardization would compromise national security. Further research could determine how to integrate security issues into the decision-making process for determining potential candidates for avionics standardization (See Table I).

The final recommendation for further research is to investigate the Deputy/Co-Deputy for Avionics Control positions. These positions are held jointly by AFLC and AFSC personnel. Some of the interviewees felt that AX's dual command allows them to "change hats", depending on a particular situation. This change in management perspective may give AX an "unfair advantage" during standardization meetings and conferences. An evaluation could determine the effectiveness/ineffectiveness of AX's dual command role.

Appendix A: Interview Questionnaire

TIME_____ DATE_____

THE PURPOSE OF THIS SURVEY IS TO ELICIT INFORMATION WHICH WILL SERVE TO IMPROVE THE EFFECTIVENESS OF AVIONICS STANDARDIZATION IN THE AIR FORCE. THE IDENTIFICATION OF THE PARTICIPANTS IN THIS SURVEY WILL NOT BE REVEALED.

THE FOLLOWING SET OF QUESTIONS ARE DEMOGRAPHIC IN NATURE AND WILL BE USED IN THE ANALYSIS OF THE RESPONSES.

1. What is your job title or position?

   a. Engineer
   b. Manager
   c. Engineering Mgmt.
   d. Other

2. What is your rank or grade?

   a. Below 0-4
   b. 0-4/0-5
   c. 0-6
   d. Below GS-12
   e. GS-12/GS-13
   f. GS-14/GS-15
   g. Other

3. How long have you been assigned to your current position?

   a. Less than two years
   b. 2-5 yrs
   c. 6-10 yrs
   d. 10 or more

4. What is your background/experience in avionics standardization?

5. How long have you been involved with avionics standardization?

   a. Less than two years
   b. 2-5 yrs
   c. 6-10 yrs
   d. 10 or more

6. How many avionics standardization programs have you worked with directly or indirectly?

7. Have you worked with an avionics standardization program that has reached operational status? How many?

THE FOLLOWING QUESTIONS ARE ABOUT THE ROLE AVIONICS STANDARDIZATION PLAYS IN YOUR ORGANIZATION.

8. What does "avionics standardization" mean to you?

9. How does avionics standardization relate to the mission of your organization?

10. At what point in the acquisition process does your organization become involved?

    a. Concept exploration
    b. Demo/Validation
    c. Development
    d. Production

11. What role does standardized equipment play in your program?

    a. Developing new standardized items
    b. Modification of existing standardized items
    c. Developing a system incorporating standardized items
    d. Breakout of peculiar items for standardized use
    e. Other

12. Who has performed the detailed review of avionics standardization applications on programs you have worked with?

THE FOLLOWING QUESTIONS RELATE TO THE DEPUTY FOR AVIONICS CONTROL AND THE ROLE THEY PLAY IN YOUR ORGANIZATION.

13. What role does the Deputy for Avionics Control have in the process of avionics standardization?

14. When does the Deputy for Avionics Control become involved in your organization?

15. What kind of relationship does your organization have with the Deputy for Avionics Control and why?

16. Do you think the Deputy for Avionics Control has helped or hindered avionics standardization and why?

17. Are representatives from the Deputy for Avionics Control involved in all meetings, conferences, etc. which involve avionics standardization issues? Why or why not?

18. Do you think the Deputy for Avionics Control has sufficient authority to carry out their mission? Explain.

THE NEXT SET OF QUESTIONS RELATE TO HOW POTENTIAL CANDIDATES FOR STANDARDIZATION ARE SELECTED.

19. At what point in the development of your program were the initial standardization decisions made?

20. At what point in the development of your program were the final standardization decisions made?

21. What information was available to support the standardization decisions?

    a. Number of using systems
    b. Maturity of subsystem technology
    c. Market demand and potential suppliers
    d. Projected advantages and disadvantages of standardization
    e. Life-cycle cost analysis
    f. Problems with integration of subsystem identified
    g. Architecture
    h. Cost effective analysis

22. When was the information in Question 21 available?

23. Would you add any other criteria that you feel are relevant in making a standardization decision?

24. What guidelines does your organization use for selecting a standardization candidate?

25. Do these guidelines differ with each program?

26. What strategies would you recommend to increase the likelihood that a developed subsystem will become standardized?

THE FOLLOWING QUESTIONS RELATE TO SPECIFIC DOCUMENTS USED BY THE DEPUTY FOR AVIONICS CONTROL TO INCREASE THE ACQUISITION COMMUNITY'S AWARENESS OF STANDARDIZATION PROGRAMS, PROBLEMS, AND ISSUES.

27. What does AFR 800-28, Air Force Policy on Avionics Acquisition Support contribute to you in your work with avionics standardization?

28. What does the Avionics Master Plan contribute to you and your work with avionics standardization?

29. What does the Avionics Planning Baseline Document contribute to you and your work with avionics standardization?

30. What does the Armament and Avionics Planning Guidance contribute to you and your work with avionics standardization?

31. Can you suggest any changes to the documents in Questions 27, 28, 29, and 30 that might improve their usefulness?

THE FOLLOWING QUESTIONS RELATE TO GENERAL ISSUES ABOUT STANDARDIZATION.

32. What percent of the time does your organization spend on standardization issues/problems?

a. 0-9
b. 10-15
c. 16-20
d. 21-30
e. 31-49
f. 50 or more

33. Do you think the Department of Defense (DOD) has placed too little or too much emphasis on avionics standardization, and why?

34. What is your position on avionics standardization, i.e. for or against? Why?

35. Do the personnel in your organization share your opinions?

36. Do you think avionics standardization has been accepted in the acquisition community? Why or why not?

37. What factors have adversely impacted the success of avionics standardization?

38. What factors have contributed to the success of avionics standardization?

39. What changes need to be made to improve the process of avionics standardization?

40. Do you think the standardization policies are effective? Why or why not?

41. What changes need to be made to the current policies/procedures to ensure success and maximize the benefits of avionics standardization?

42. Which of the following strategies do you think would increase the likelihood that a developed subsystem will be standardized?

    a. Mandate the use of the subsystem through the contract or through rulings of the Secretary of Defense.

    b. Persuade the program manager to accept the subsystem.

    c. Provide economic incentives to the contractor to use the developed subsystem.

    d. Reduce the level of system optimization and performance extremes (design to cost).

    e. Emphasize reliability and maintainability, development cost, and low risk in the system specification.

43. How would you force implementation of the strategies you selected in Question 42?

Appendix B: Summary of Responses

1. WHAT IS YOUR JOB TITLE OR POSITION?

1. Engineering Management
2. Engineering Management
3. Engineering Management
4. Engineering Management
5. Engineering Management
6. Manager
7. Manager
8. Engineering Management
9. Manager
10. Engineering Management
11. Manager
12. Manager
13. Manager
14. Engineering Management
15. Technical Management
16. Engineering Management
17. Manager
18. Engineering Management
19. Manager
20. Manager
21. Engineering Management
22. Engineering Management
23. Manager

2. WHAT YOUR RANK OR GRADE?

1. O-6
2. SES
3. GS-14/15
4. GS-14/15
5. GS-14/15
6. SES
7. O4/O5
8. O-6
9. GS-14/15
10. O4/O5
11. GS-12/13
12. GS-14/15
13. O-6
14. GS-14/15
15. Below O-4
16. O4-O5
17. GS-14/15
18. GS-14/15
19. GS-14/15
20. O-7
21. GM-15
22. GS-14/15
23. GS-14/15

3. HOW LONG HAVE YOU BEEN ASSIGNED TO YOUR CURRENT POSITION?

1. 2-5 yrs.
2. 2-5 yrs.
3. 10 or more
4. 2-5 yrs.
5. 10 or more
6. Less than 2 yrs.
7. 2-5 yrs.
8. Less than 2 yrs.
9. 2-5 yrs.
10. 6-10 yrs.
11. Less than 2 yrs.
12. 6-10 yrs.
13. 2-5 yrs.
14. Less than 2 yrs.
15. Less than 2 yrs.
16. Less than 2 yrs.
17. 6-10 yrs.
18. Less than 2 yrs.
19. Less than 2 yrs.
20. 2-5 yrs.
21. Less than 2 yrs.
22. 2-5 yrs.
23. 6-10 yrs.

4. WHAT IS YOUR BACKGROUND/EXPERIENCE IN AVIONICS STANDARDIZATION?

1. EN, branch chief, warning and control; chief avionics engineer on the B-1; system program director in YY, Strategic Systems SPO; system program director in B1.
2. None directly; however, we encourage standardization in our programs, e.g. CTUS for multiple aircraft, common module FLIR, and radar PSP.
3. AE, worked in MATE SPO; Armament and Avionics Planning Conference - 5 years; now work in RW.
4. Been involved in the study that established AX and been involved ever since.
5. Have been involved in avionics system architecture for over 20 years.
6. Chairman - Common/Commercial/Avionics Subpanel of Standardization Panel and member of the Joint Services Review Committee.
7. Chief avionics engineer in B-1 SPO and Director of Plans and Mgmt. Information in AX.
8. 27 years experience in standardized and non-standardized avionics; advisor to the 1st chief of AX.
9. Program manager for Standard INU for past 2 years;

8 yrs. experience in avonics acquisition.

10. Limited - this job only as Director of Combat ID SPO.
11. Have only worked indirectly with standardization; used standardized parts on my program.
12. Program manager of modifying existing aircraft to use new systems. Proposed systems have included those for which a standard exists as a possible solution.
13. Worked on the standard flight data recorder for 3-4 years.
14. 1969-76 worked on avionics equipment modifications and F-111 operational flight programs (SM-ALC); 1976-80 engineering/ASD, avionics computer resources; 1980-present work on avionics architecture and architecture standards.
15. Wrote AFR 800-28; Created AX; Implemented 800-28.
16. On ASD staff responsible for writing 800-31; on ASD staff responsible for helping to write 800-41, which stipulates how organizations manage subsystems; Deputy director of AE - managing standard programs.
17. Rated officer with the KC-135 and E-3A experience (8 yrs); knowledge of aircraft instruments as they pertain to these aircraft; Rated sup. assignment in July 1983 to integrated controls and displays branch in Directorate of Avionics Eng. till January 1985; currently in F-15 avionics.
18. I started AX in 1978 - was the first employee and have worked here ever since.
19. 4 years worked on computer interface and programming lanaguage standards; 5 yrs worked in controls and displays in EN, tri-service standard for symbology.
20. Avionics R&D program management; subsystem integration and demonstration.
21. Involved in discussions about the formation of AX; worked on electronic engineering steering committee; worked in ENA before coming to this organization.
22. Worked as a program manager and dealt with avionics standardization in that capacity.
23. Tri-service standardization of infrared hardware in early 70's; typically some standard hardware on every program since then.

5. HOW LONG HAVE YOU BEEN INVOLVED WITH AVIONICS STANDARDIZATION?

1. 10 or more
2. 10 or more
3. 6-10 yrs.
4. 2-5 yrs.

5. 10 or more
6. 10 or more
7. 10 or more
8. 10 or more
9. 10 or more
10. Less than 2 yrs.
11. 2-5 yrs.
12. Less than 2 yrs.
13. Less than 2 yrs.
14. 2-5 yrs.
15. 2-5 yrs.
16. 6-10 yrs.
17. 2-5 yrs.
18. Less than 2 yrs.
19. 6-10 yrs.
20. 10 or more
21. 6-10 yrs.
22. 10 or more
23. 2-5 yrs.

6. HOW MANY STANDARDIZATION PROGRAMS HAVE YOU WORKED WITH DIRECTLY OR INDIRECTLY?

1. 2 programs.
2. More than 10 programs.
3. Many.
4. 4 programs indirectly.
5. More than 7 programs.
6. A bunch!
7. Almost all of the programs.
8. More than 50.
9. Almost all of them.
10. Most all of them; engineers support all programs at ASD.
11. One directly, three indirectly
12. Two programs
13. There are standardized parts included in my program.
14. 3 programs.
15. 1 program.
16. Two directly and 6 indirectly.
17. All of them.
18. Have worked as deputy director of 10 programs indirectly.
19. Mil-Std 1553B interpretation directly and another indirectly.
20. 25-30 programs.
21. 6 programs.
22. 4 programs.
23. 2 programs.

7. HAVE YOU WORKED WITH AN AVIONICS STANDARDIZATION PROGRAM THAT HAS REACHED OPERATIONAL STATUS? HOW MANY?

1. Yes, but worked on the program before it became operational.
2. Yes.
3. Yes, at least 8.
4. Yes, four programs.
5. None really called "standardization programs". Instead they were indirectly standardized - About 4 of those.
6. Yes, 3 programs.
7. Yes, don't know.
8. The only program which is not operational is ATF avionics.
9. Yes, 5-7 programs.
10. Yes, about 6.
11. 70-80% of all standardization programs.
12. Yes, 1 program.
13. 1 program.
14. None.
15. Yes, one program.
16. Yes, 1 program.
17. Yes, two programs.
18. Yes, several programs.
19. 3 std programs have been deployed - several others are imminent.
20. None.
21. Yes, a number of them.
22. Yes, 4 programs.
23. Yes, 1 program.

8. WHAT DOES "AVIONICS STANDARDIZATION" MEAN TO YOU?

1. Standardization at many levels (interface, software, physical, functional and hardware) are tools which are evaluated for configuring an avionics system and used when possible to save money or reduce cost.
2. Utilizing the same LRU (with or without interface) on more than one aircraft. Applications are generally multi-service.
3. Using common equipment where it makes sense.
4. It has become a buzzword; the answer is to say "standardize without asking questions; F3 standardization - with some control of function; least interested in hardware.
5. Multiple applications for a single end item/LRU; directly replaceable without modification to weapon system; any standard can be used when one standard has been qualified for use.
6. Another factor to consider and a noble objective.

7. Hardware and software standards (e.g. 1553b, 1750), ADA, common modules, et al to lower acquisition and LCC.
8. It's being currently implemented - various subsystems have been selected as "standards". Any new weapon systems coming along, or modifications, are being driven to use these systems instead of alternate subsystems which perform the same tasks.
9. Application of generic avionics across different types of aircraft. The avionics don't have to be identical.
10. Rational avionics standardization means affordable avionics available to successfully accomplish the Air Force mission during the life of a weapon system without any ill-effects on its performance.
11. Interface standards, core avionics, mission avionics, MATE, PAVE PILLAR, ICNIA.
12. Common subsystems, SRUs, or F3 architecture for multiple mission design series (i.e. F-15A, F-15B, etc.).
13. Standard components and standard modules rather than standard documents.
14. Architecture interfaces - the way to go in the future. We are trying to lead the Air Force into that mode.
15. Use of interfaces or hardware to build avionics systems with a goal of reducing acquisition and support cost, multiple applications and reuse, use of common hardware and/or software or support.
16. Essential: necessary and sufficient definitions of all electrical/electronic interfaces (quasi-generic).
17. Buses, instruction sets, languages, dimensional, and modular standards. When you standardize you have to give up something, so you must look at "what" standard and "where" it is going to be applied.
18. A device which meets a "standard interface" and can be used in more than one system.
19. Use of existing designs/hardware/software by more than one user.
20. Try to stop the proliferation of "standard" items of equipment and software.
21. Use of standard equipment/components to the maximum extent possible to avoid logistics, reliability, compatibility, and performance problems that often result from using unique equipment.
22. Not answered.
23. Lower cost for a given mission effectiveness.

9. HOW DOES AVIONICS STANDARDIZATION RELATE TO THE MISSION OF YOUR ORGANIZATION?

1. One of the considerations which must be evaluated when considering engineering changes to existing systems or developing new systems.
2. Instrumentation by definition is multi-aircraft related. Therefore, my mission is "standardization". My branch and I are heavily involved in branch "related" standardization activities.
3. For EN, use standardization where and when it makes sense.
4. Support all avionics systems at ASD - but are not enforcers.
5. Primary mission of my program.
6. Has a direct bearing on the programs I work with - they are standard. Give and take goes along with it.
7. We address it obliquely - consideration is given to it, but scarce R&D dollars are not wasted on prototype efforts just for the sake of standardization. AX is briefed occasionally.
8. Major aircraft modification - 3 subsystems being implemented which fall under standardization.
9. We accept it if it makes sense - it is unacceptable if it doesn't make sense.
10. It is one of our objectives. However, we indulge in only promising initiatives which allow P3I objectives and reduces the ownership cost of our avionics.
11. We adopt the standards whenever it makes sense.
12. We manage the acquisition of subsystems for multiple mission design systems applications.
13. Area to be aware of and apply where applicable. We use standard documents although they don't always lead to standard items.
14. It is the mission of this organization.
15. Our mission is to reduce the cost of acquiring and maintaining avionics as well as ensuring technology transition. If we can successfully identify interface standards (with hardware and software) we can accomplish both missions.
16. Avionics upgrades are a major part of system modernization. The potential savings in support costs will not be realized without standardization.
17. It does not relate directly to this organization. AX advises us sometimes.
18. We incorporate "standard" systems.
19. Just one of many management/technical issues.
20. The software, computers, and communication gear are USAF standards.
21. In each new organization, consideration is automatically given to use of standard equipment.

22. (Not answered)
23. It is an integral part of our mission.

10. AT WHAT POINT IN THE ACQUISITION PROCESS DOES YOUR ORGANIZATION BECOME INVOLVED?

1. Concept exploration
2. All phases
3. All phases
4. All phases
5. All phases
6. Concept exploration
7. Concept exploration and Demo/Validation.
8. Development
9. Concept exploration
10. Concept exploration
11. Demo/validation and Development and Production
12. Demo/validation
13. Development and Production
14. Demo/validation
15. Concept exploration and Demo/validation
16. Concept exploration
17. Concept exploration
18. All phases
19. All phases but mostly development
20. Development and Production
21. Development
22. (Not answered)
23. Concept exploration

11. WHAT ROLE DOES STANDARDIZED EQUIPMENT PLAY IN YOUR PROGRAM?

a. Developing new standardized items
b. Modification of existing standardized items
c. Developing a system incorporating standardized items
d. Breakout of peculiar items for standardized use
e. All of the above
f. Other

1. c
2. All of the above
3. All of the above
4. All of the above
5. a, b, and d
6. b
7. Use it as it is available and makes sense to accomplish program objectives.
8. b and c
9. a and use standardized items
10. Analyzing system architectures and evaluating mainly the application of architectural standards, and, to some extent, application of form, fit and function hardware item standards.

11. c
12. a, b, and d
13. c
14. Control of avionics
15. a, b, and d
16. Other
17. Other - N/A
18. b, c, and d
19. All of the above
20. c
21. c
22. (not answered)
23. All of the above

12. WHO HAS PERFORMED THE DETAILED REVIEW OF AVIONICS STANDARDIZATION APPLICATIONS ON PROGRAMS YOU HAVE WORKED WITH?

1. Each engineer works his own issues at his own discretion. Engineers consider standardization because it saves them time in the long-run - they are not forced by anyone because it makes sense.
2. My engineers working on their programs or my engineers who support the SPOs. Engineers have been indoctrinated. They look for potential programs but generally nothing comes of it.
3. Engineers apply standardization. But, by PDR and CDR the design is set and standardization applications do not occur.
4. Chief avionics engineer and project (equipment) engineer when laying out the functional requirements at the beginning of the program.
5. By definition, my program is a standard. Therefore all applications use standards. Program has been reviewed at all levels, AE, ASD/CC, AFSC/CC, USAF/RDP/LEY, SAF/AL.
6. AX early on in the program. They understood the basis for future decisions and helped with the policy for specifications.
7. N/A
8. Everyone from AX up to the SAF.
9. AX and through them the JSRC. The procurement approach was briefed to DMSO. The tri-service working group was a part of the PDR and CDR. As part of the contract, the contractor had to show how changes would be made for application to other aircraft.
10. Engineering within each SPO. However, we provide an independent assessment on avionics systems.
11. Program office, logistics, engineering.
12. We review standardization applications in addition to the division chiefs.
13. During my time at ENA, the contractor was tasked

to look at standard components for use. On the current program I'm working on, the engineers look at standardization and how it relates to your program.

14. My office.
15. ASD/ENA, and ASD/AXT
16. The integration contractor; with remote terminal units tested at the EN SEAFAC (which by the way was an inadequate test, since units that passed the SEAFAC test didn't work then).
17. For the racking and mounting standard, used extensive EN and some laboratory support.
18. ASD/AX
19. Early 70's the tri-service JTCG's under the JLC did. Mid 70's EN did. Recently AX and EN.
20. ASD/AX and EN
21. ASD/AX
22. (not answered)
23. Depends on the program. There is currently a proposal for XR to institute an avionics architectural division. EN doesn't agree. AX should be in a policing function but they have a tendency to work in a generating function.

13. WHAT ROLE DOES THE DEPUTY FOR AVIONICS CONTROL HAVE IN THE PROCESS OF AVIONICS STANDARDIZATION?

1. Policeman
2. They are policemen to ensure that standardization gets implemented IF it is cost effective.
3. AX has the responsibility to maximize standardization but not the authority.
4. Policeman
5. They are the focal point at ASD for avionics standardization issues. They are responsible for recommending waivers being granted IAW AFR 800-28.
6. Initial impact, RFP review and coordination, and policy. Before contract is signed, waivers must be approved by AX.
7. Responsible for coordination/implementation
8. Determining what should be standardized, ensuring standards are being used, and moral suasion for programs not using standards.
9. They introduced me to the tri-service and negotiated requirements between the program manager, General Dynamics and the tri-service group.
10. Acts as the conscience of the avionics community. Challenges contractors when they purposely lead program managers on courses which does not have the best interest of the AF in mind.
11. Policemen on the block.
12. Advocate and identification of opportunities.
13. Implements and maintains the avionics standardization programs through the avionic

standardization planning council and planning guidance (tri-service).

14. N/A (in AX).
15. Proponent or advocate for interface standards and F3 standards.
16. Establishment of the standard.
17. Charged with identifying equipments which have potential for common use across weapons systems; designating that common use and ensuring that use.
18. They approve the systems we are incorporating.
19. Review avionics RFP's.
20. Focal point
21. Make everyone aware of what is standard and police new procurements to maximize commonality.
22. (not answered)
23. Large. The policemen of avionics standardization.

14. WHEN DOES THE DEPUTY FOR AVIONICS CONTROL BECOME INVOLVED IN YOUR ORGANIZATION?

1. Review of SOWs, RFPs, and avionics system specifications.
2. Daily - but my organization is an exception. A lot of people don't know that AX exists.
3. Hardly ever.
4. At all stages, but they are sometimes too late. We try to avoid a confrontation.
5. They have been involved in my programs during all phases, primarily as advisors/staff agency.
6. At the beginning, during the development phase.
7. Became involved after contract award.
8. After contract award of the FSD contract.
9. After a briefing of my program to the steering committee at the HQ USAF level, I had a message to call Ken Ricker at AX. At program inception.
10. Prior to contract award - as early as possible. They review the PMD, PADs, SONs, etc., assist in the writing and the wording for the SOW, and Specs, and evaluate RFPs, waivers, etc.
11. Review RFPs, processes waivers.
12. They are normally involved before we get the standard program. There are four key players - the first is the aircraft weapon systems program office, second the logistics command systems manager, third air staff, and fourth AX.
13. Processing and approving waivers. We deal with AX in matters of interpreting the military standards.
14. N/A
15. N/A
16. When requested by the 2-letter chief.
17. Get involved with AX as an independent consultant that have little to do with standardization.
18. At program reviews.
19. Reviews avionics RFPs.

20. During program start-up.
21. Usually as early as review of RFP, but it varies with each program. It should be earlier than when they do get involved.
22. Primary contact is through the A&A Planning Conference - we incorporate standardization programs into our programs.
23. Early in the program.

15. WHAT KIND OF RELATIONSHIP DOES YOUR ORGANIZATION HAVE WITH THE DEPUTY FOR AVIONICS CONTROL AND WHY?

1. In the past EN has supported AX and created standardized programs through AX. Not sure now what role AX plays.
2. Direct - I am a member of the JSRC.
3. Perfunctory because AX comes in at the 11th hour of a program and tries to force standardization on the program manager when it is too late to make changes.
4. Strained at times and often at odds. They have no agreeable life-cycle model and rarely make a good case for standardization.
5. I would typify our relationship with AX as a "wait and see". AX organizationally performs no visible support role for ASD program agencies. They are advisory only. Their "dual hat" role, i.e. AFSC/AFLC, lets them take different positions depending on the track they want to take to solve issues.
6. Not much after contract award except for major reviews.
7. Periodic information briefings - infrequent and unscheduled.
8. Generally good - even though there are programmatic reasons why we don't agree with their positions. They tend to be "ivory towers" and they think we don't appreciate the value of what they are doing.
9. Generally good. They have been very cooperative with me. I got good advice and enjoyed the relationship. (If the requirement cost more money than we had to spend, we wouldn't have like it).
10. Typically <u>sweet</u> adversary role if issues exist. However, once a final decision is reached and a contract is awarded, AX <u>fully</u> supports the decision and helps program offices to defend it at whatever level is needed.
11. OK, because I understand and agree with their mission.
12. Strained because a "standard" program was so disasterous (we didn't like AX's adversarial role), and loose because there are no "formal" ties with AX.
13. Administrative and advisory.

14. N/A (Worked in AX).
15. N/A (AX). Should use AX in an advisory role in selection of standards to incorporate into RFPs.
16. Not much because our organization is primarily vehicle-oriented and has transferred some previous standardization-funded work out of the organization.
17. We had a close relationship because of Lou Urban, but it is slowly fading away. We still have a cordial and helpful relationship because of personal capabilities.
18. Coordination.
19. Typical matrix relationship. They review RFP's as does engineers, configuration control, etc. - just one of the team players.
20. Cooperative - but not necessarily in agreement.
21. "Weak." Don't have a solid strong (good or bad) relationship.
22. Don't really get involved with AX. They review RFPs, but we don't look to AX to "chop" them.
23. At working level, cooperative, but it is more difficult at the higher levels of management.

16. DO YOU THINK THE DEPUTY FOR AVIONICS CONTROL HAS HELPED OR HINDERED AVIONICS STANDARDIZATION AND WHY?

1. In the beginning of AX they provided added emphasis on standardization. Now they have little or no impact on standardization since the implementation is primarily an engineering and program management function.
2. They have helped - they have proclaimed standardization throughout the DOD.
3. They have clearly hindered - AX's attitude is to standardize regardless of the consequences. They also get SPOs mad at them because if a SPO doesn't agree to standardize, AX goes up to HQ AFSC for help and then AX has made an enemy of the SPO.
4. They have helped in obvious ways and they have hurt in subtle ways. Specifically, they have forced standardization, without a good case, and now people are gunshy with the word "standardization".
5. Both. They have been very active in promoting the objectives and goals of standards, but their actions have hindered the effective and efficient implementation of these goals and objectives.
6. Just another staff agency - required input. The question to be posed is - Is standardization always good?
7. Helped because a focal point is needed to "watchdog" and push program managers to keep standardization in a high level of consciousness.
8. They have helped in the sense that as a result of

their efforts more systems are being standardized. Except I'm not sure it's always good to standardize.

9. Helped me on this program - couldn't have standardized without AX's help. However, selling standardization is also selling compromise.
10. Having been in ALC, ASD and now in a joint organization, I definitely feel AX has helped standardization by focusing on promising standardization initiatives. Have now tremendous support from industry as a whole.
11. Helped. Did the studies that showed benefits of rational standardization.
12. Because they take the role of crusaders, they haven't helped the cause.
13. Hindered - interface equipment for a "black box" is very difficult to do and is at a higher level of standardization than it should be. However, when I was assigned to ENA, I looked for ways to standardize the "black box".
14. N/A
15. Has helped by providing some seed money, also seeking industry acceptance of standards.
16. Helped in a limited sense by raising the issue, then advocacy in the A&A Planning Conference, and some subsystem success stories, e.g. the common air data computer.
17. Helped- has it helped too much? (probably not).
18. No impact. We support the concept of standardization, but AX has a bad philosophic concept about standardization and we don't support the policies of AX and won't be pushed around by them.
19. Overall have helped - attention, guidelines and some policy on standardization.
20. Both where technology was readily available we used it and where it wasn't we didn't.
21. Helped initially. Not as helpful now as they used to be (maybe the need was greater before or maybe their charter is somewhat temporary). They have not made as much progress as they should have.
22. They have helped - but stepped on it when they forced a standard on a SPO.
23. Could make an argument on either side. Some of the actions AX takes is helpful in the short-term but harmful in the long-run.

17. ARE REPRESENTATIVES FROM THE DEPUTY FOR AVIONICS CONTROL INVOLVED IN ALL MEETINGS, CONFERENCES, ETC. WHICH INVOLVE AVIONICS STANDARDIZATION ISSUES? WHY OR WHY NOT?

1. No. All meetings associated with implementing an

avionics system involves standardization in one way or another and there's not enough manpower.

2. No. I represent AX at these meetings and report to them. They are usually not invited because organizations want to think through potential standardiztion programs without being forced by AX. They get a SPO viewpoint and then call in AX.
3. First, AX is based at ASD so the SPOs at SD and BMO don't know they exist. ESD has had some contact with AX but it hasn't been favorable. EN generally doesn't invite AX because of the attitude they take on standardization.
4. Yes and no. They are excluded from some meetings but typically are invited to EN meetings. They are usually excluded when the participants feel that emotional issues need to be avoided.
5. No, manpower limitations preclude attendance at every meeting. They are advised and invited to attend on major/critical meetings/conferences which involve standardization.
6. Typically they are but only at major meetings. They would be a hinderance if they were invited to all meetings.
7. N/A
8. Generally yes - occasionally not because we forget.
9. Yes, because of the relationship we had.
10. Impossible to do that. Standardization is not the primary objective of AX. It is only one of the secondary objectives. The primary objective is to decrease the avionics ownership cost while increasing/sustaining performance. Therefore, from limited resources (50 people) we can only support key meetings, conferences, and promising initiatives.
11. Don't know. We try to remember to invite them.
12. They used to be - haven't been lately because of the problems we've had with them.
13. No. They are not directly involved in our meetings. We go to them if we need them.
14. N/A
15. Not all meetings.
16. Don't know - doesn't really apply.
17. N/A
18. Yes. We do look for opportunities to standardize when it can be integrated into our aircraft.
19. No. Some of our subsystems are older and joint with the Navy. They are not knowledgable. Some standardization is non-avionics.
20. Yes.
21. Yes, to some limited extent. We don't always have standardization issues which surface to the top.
22. No - unless it's a specialized situation. They just normally don't have authority to carry out

their mission.

23. No. There are too many meetings and not enough AX personnel to man all meetings.

18. DO YOU THINK THE DEPUTY FOR AVIONICS CONTROL HAS SUFFICIENT AUTHORITY TO CARRY OUT THEIR MISSION? EXPLAIN.

1. They may have the authority, but they do not have the manpower or capability to police all avionics efforts underway in the Air Force. Also, I'm not sure this is required
2. Yes, but they do not exercise it fully too often. Weak management at the 0-6 level and the joint AFLC-AFSC command mode they are currently in are factors.
3. They are given no authority whatsoever IAW AFR 800-28. When the regulation was originally written the authority was there but was specifically deleted during the coordination process.
4. The current regulation is balanced - it gives them sufficient authority - the power they have is as good as their arguments. To give them more authority would upset the checks and balances.
5. They have authority but do not take responsibility. They currently work as a staff agency and rely on line program offices to enforce standardization guidelines.
6. Yes. They have authority through the required coordination cycle.
7. Don't know - not familiar enough with AX.
8. Sure - individuals create their own authority - will be less successful if they use regulations to get their point across.
9. The paperwork probably says they do, but they probably don't because there are ways to get out of standardization.
10. The Deputy for Avionics does not make decisions, it only identifies the opportunities for application of standards, makes sound recommendation based on LCC or technical practicality and common sense. The decision is left up to the proper authorities. In addition to this influencing approach, it facilitates the use of key standards.
11. Yes, they have commander support.
12. Yes, their problem of ineffectiveness is born of their behavior not their authority. Since Lou Urban died, they lack technical expertise.
13. Can't answer because of my lack of involvement with AX.
14. No - lack of strong support from AFSC/AFLC HQ.
15. No. The AX deputy is only an 0-6 versus SPO

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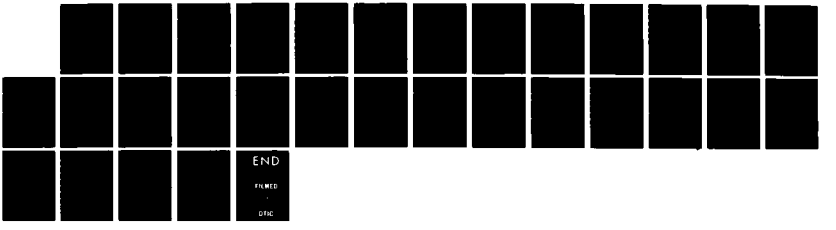

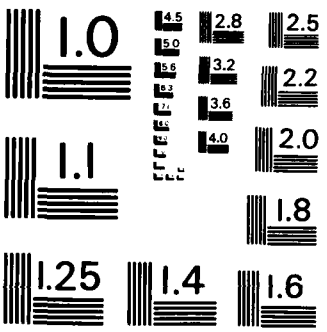

directors with higher rank.

16. No. The clout is given to the aircraft prime contractor.
17. Their mission is a peripheral one. My perception is that AX pushes standardization.
18. No, but they shouldn't have the authority to make the programmatic decisions which should be made by the program manager. We listen to what they say and then we make a decision which doesn't necessarily agree with AX.
19. They plow around a lot - but don't do much standardizing. They don't have authority because they are just advertisers - the SPOs originate standards and implement the standards. If AX didn't exist we would still have standards.
20. Too much - AX takes a hard stand on standardization without understanding the feasibility aspect of standardizing - the AX engineers should get put with EN engineers so they have a better understanding of the real world.
21. No, because there is a lack of emphasis by general officers at ASD, HQ AFSC, HQ AFLC. Their authority is not recognized.
22. No - don't do business in that manner. SPOs are concerned with meeting cost and schedule milestones - they are not graded on how many standardization programs they incorporate into their program, *unless it's <u>not</u> an inconvenience.* Because of the focus on centralized decision-making at the program management level, it's doubtful if AX will get any more authority.
23. Yes, as a police force they can raise questions to the command level. They can't expect to usurp command authority. They have as much authority over the program manager as a police force needs to have. The SPOs must maintain their autonomy.

19. AT WHAT POINT IN THE DEVELOPMENT OF YOUR PROGRAM WERE THE INITIAL STANDARDIZATION DECISIONS MADE?

1. In all avionics programs, the initial decisions on standardization are made along with other configuration decisions at the time of system concept.
2. Mostly full-scale development but also in other stages.
3. During concept exploration.
4. During the preliminary design phase - SRR and PDR - the decisions were subject to refinement.
5. From inception, my program is a standard.
6. Early. Entry into the development phase.
7. None made, except for contractor's commitment to HOL is practical. This was to his advantage (and

ours) to facilitate technology transition.
8. Had a baseline program - during comparative evaluation between two programs standardization was not an issue. After contract award AX looked at standardization.
9. At the time we got funding and briefed DMSO we received PMD direction to make use of tri-service specification.
10. Typically in establishing the avionics baseline for the RFP package.
11. Initial program review (IPR).
12. Most decisions were a series of small decisions. There was no "flash of light" for making decisions.
13. The source selection evaluation and the request for proposal.
14. N/A
15. Should be made before RFP stage.
16. N/A
17. N/A
18. Early.
19. Some started with specifications, some with demonstrations and some with hardware.
20. At the very beginning.
21. Usually during the early part of FSD.
22. (Not answered).
23. During concept development.

20. AT WHAT POINT IN THE DEVELOPMENT OF YOUR PROGRAM WERE THE FINAL STANDARDIZATION DECISIONS MADE?

1. The final decisions are made during the full scale development.
2. Production decision.
3. During FSD.
4. All the way to the end.
5. N/A.
6. Haven't been made yet - goal is still complete standardization.
7. We did change configuration of our program for supportability, reduced OFP task, technology transition.
8. Yes - last one was about a month ago.
9. At the time of the "box" concept they were made. For follow-on acquisitions we want to set up a second source. Competition and standardization both have benefits, but competition advocates usually have a bigger say.
10. Prior to contract award.
11. CDR.
12. The applications decisions have not been made.
13. They are still being made and will be until the system is accepted by the government.
14. N/A
15. Should be made at the RFP stage.

16. N/A.
17. N/A.
18. They are still being made.
19. Usually by demonstration.
20. At the start of development.
21. Mid-FSD.
22. At RFP.
23. Can modify the system anytime after concept development.

21. WHAT INFORMATION WAS AVAILABLE TO SUPPORT THE STANDARDIZATION DECISIONS?

a. Number of using systems
b. Maturity of subsystem technology
c. Market demand and potential suppliers
d. Projected advantages and disadvantages of standardization
e. Life-cycle cost analysis
f. Problems with integration of subsystem identified
g. Architecture
h. Cost effective analysis
i. All of the above

1. d, e, and g
2. i
3. None was available.
4. Other. Preferred standardized equipment list, AMP, A&A PG, and the *APBD*.
5. i
6. a, c, d, and e
7. f
8. a, b, d, e, f, g, and h
9. a, b, c, and f
10. i plus schedule and performance.
11. i
12. i
13. can't answer but (f) is important.
14. N/A
15. a, b, d, and g
16. N/A
17. N/A
18 d and e
19. a, b, e, f, and g
20. i
21. a, b, and e
22. i
23. a, b, c, d, f, g, and h

22. WHEN WAS THE INFORMATION IN QUESTION 21 AVAILABLE?

1. Early in the development stages of an avionics system development.
2. We at EN develop this information. On the average, it takes 4 months for a draft and 6 months for the

final. Total 10 months.

3. None of the information was available. AX said standardize because the regulation says so.
4. The information listed above is available at all times.
5. At the time of source selection.
6. End of concept exploration at DSCARC I.
7. Midway in development program (Demo/Validation phase).
8. When we were fighting standardization we used the above information as arguments. When we were agreeable to use standardization, it was not necessary.
9. At the time the standardization decisions were made.
10. Most of it during source selection.
11. IPR---->CDR
12. Usually don't have all the information - have to keep working the program till everything clicks.
13. At source selection and when you are modifying the system.
14. N/A.
15. (Not answered).
16. N/A
17. N/A
18. Before the standardization decisions were made.
19. Development-production.
20. At the start of the development program.
21. At the time of proposal evaluation.
22. At the time of RFP.
23. At the time the standardization decisions were made.

23. WOULD YOU ADD ANY OTHER CRITERIA THAT YOU FEEL ARE RELEVANT IN MAKING A STANDARDIZATION DECISION?

1. The major reason for using standards in Air Force avionics systems is to reduce cost (acquisition and O&M).
2. No.
3. (Not answered).
4. The information listed in Question 21 should be used. Also, I look at function of alternatives to solve. Standardizing sometimes can hold technology back.
5. No.
6. Function of equipment.
7. Not familiar enough with standardization to have definite opinion.
8. Schedule impact and resultant cost impact. Also, applied to new programs rather than modification programs.
9. No.
10. Level of standardization is important in

establishing criteria. Architectural, F3 and hardware (at subsystem, box or piece parts etc.) levels will have different criteria.

11. No.
12. Comfort level of SPO director - unexpected disturbances can be disasterous.
13. No.
14. Operational capability, supply support and system/subsystem support.
15. (Not answered)
16. No.
17. No.
18. F3 doesn't work in a highly integrated, software-intensive system...you must take the time to define all interfaces.
19. Compromise of multiple weapons systems by a single enemy action. When we have standards on weapons systems which we are selling to other countries, we are taking a chance on the enemy finding a way to jam the system and make it useless, e.g. ECM.
20. Realistic assessment of risk - the LCC models do not account for risk.
21. Performance criteria. Higher reliability is relevant to the decision and should be considered.
22. (Not answered).
23. The technical risk of standardization.

24. *WHAT GUIDELINES DOES YOUR ORGANIZATION USE FOR SELECTING A STANDARDIZATION CANDIDATE?*

1. The cost savings offset the disadvantages of standardization.
2. Subjective - on a case-by-case basis.
3. Size, volume, form factor; how will it perform?; what is it going to cost?; what about the schedule?
4. Offer more than one alternative, i.e., a full-blown standardized system, no standardization, and something in-between.
5. Competitive source selection.
6. We don't. AX decides and sets standards.
7. Does it make sense for application to 6-3 programs?
8. The ones AX has proposed to us - the planned subsytems.
9. Would have to do the job (performance) and would have to be practical.
10. Different guidelines for different levels of standardization.
11. Use unless not smart.
12. We build standard items. Our role is to develop the standard items which have been decided by AX.
13. The planning conference that AX puts out and direction/policy letters from senior officers (i.e. McMullen, Scantze, etc).
14. Broad applications and relatively stable

technology.
15. (Not answered)
16. N/A
17. N/A
18. Can it be integrated into our system without costly modification and will it do the job?
19. Some of the above.
20. Good judgment
21. None. We don't have any formal procedures for standardizing.
22. (Not answered).
23. We suggest rather than select candidates and there are no set guidelines we use.

25. DO THESE GUIDELINES DIFFER WITH EACH PROGRAM?

1. Yes
2. Yes
3. No
4. Depends on the program phase, the direction, and the objectives. These can limit preliminary designs and systems engineering.
5. No
6. Ask AX
7. No
8. Yes - for AX to do their job - they need to go in during the acquisition strategy rather than after contract award.
9. Varies from program to program.
10. Guidelines are the same, however, application of standards is determined on program-by-program basis. This is very much analogous to source selection criteria and, typically, weighing of factors differ from program to program.
11. No
12. Yes
13. Yes - they are program specific but the risk/ schedule impact must be known.
14. N/A
15. (Not answered)
16. N/A
17. N/A
18. Yes
19. Yes
20. Yes
21. Yes
22. (Not answered)
23. Yes

26. WHAT STRATEGIES WOULD YOU RECOMMEND TO INCREASE THE LIKELIHOOD THAT A DEVELOPED SUBSYSTEM WILL BECOME STANDARDIZED?

1. Standards should be broader in scope such as interfaces, physical sizes and software techniques rather than specific built-to-print hardware which cannot satisfy a wide variety of needs. An example would be standardized modules or cards because the missions of airplanes are different which makes a higher order standardization more difficult.
2. If it is a more cost-effective DOD or Air Force decision. (Convince SPO director or program manager).
3. A glowing report - cheap, on schedule, everybody is happy. This is an infrequent occurrence.
4. Stress the limits on encompassing tomorrow's and today's technologies but not past technology. The trend should be cheaper, smaller, lighter. During development, should use state-of-the-art technology.
5. Commitment from major weapon systems to use it and funding identified in POM to ensure adequate implementation and maintenance of standards.
6. Get all using platforms to agree to the requirements up front. Typically, users end up adapting standards to fit the system because requirements weren't completely defined early.
7. Applications of the design standards (1553B, 1750, et al) will take care of standardization.
8. Ejector program is a good example - we blended requirements of both the F-15 and F-16 so the ejector will work on both aircraft.
9. There ought to be a way to check and see if there is a standard that will work. Nobody seems to know or care what standardized equipment exists.
10. Commercial applications do not exist, number of buys are small (assuming a fast-moving technology), second/tertiary sources exist, and development cost can be justified to reduce the overall cost, etc.
11. More interested in interface standards than hardware standards.
12. Selling the program to weapons system program offices. A reasonable match depends on the comfort level of the SPO director.
13. In ENA - cost benefit analysis and require contractor to show why he isn't using standards. In SPOs - break into smaller standard components or standard modules with widespread application (very difficult).
14. Standard sizes and connectors. MIL-STD-1788 digital interface and MIL-STD-1553B.
15. (Not answered)
16. Multi-application requirements analysis before start of FSD, common modules design standard digital interface, and multiple contractor sources.

17. An organization that is developing weapon system-peculiar equipment should have information about other, related weapons systems. The requirements could be incorporated into that 1st development, which would render it a better candidate for standardization. The focus shouldn't be only on the 1st system being developed.
18. Integration is the whole issue. If all interfaces are defined and integration is no problem than it should be standardized.
19. None. Standardization doesn't help the new thrusts, i.e. competition, etc. It is not obvious that more is better - complicates updates/retrofits.
20. None
21. Identify in requirements, the things that make it readily adaptable to other aircraft (e.g. interfaces, 1750, HOL), make it a highly reliable system, use most recent technology, and go to potential users and size up their requirements, but go informally and don't rely completely on the PMDs.
22. Standardize interfaces not the hardware, and build the infra-structure of avionics architecture to be transparent to the LRU - e.g. line-replaceable modules.
23. Use a good life-cycle cost model.

27. WHAT DOES AFR 800-28, AIR FORCE POLICY ON AVIONICS ACQUISITION SUPPORT CONTRIBUTE TO YOU IN YOUR WORK WITH AVIONICS STANDARDIZATION?

1. Establishes guidelines to be considered in creating avionics systems.
2. As a member of the JSRC it means a lot - as a regular engineer I probably wouldn't know about it.
3. Nothing
4. Supports avionics conferences, helps to prepare the AMP and is used by SPOs partly to waiver the use of standardization.
5. Use it in implementing standards, must request waiver when I can't comply.
6. Policy, guidance, requirements.
7. Don't know what it is.
8. Although I know there is a standardization regulation, I'm not familiar with this regulation.
9. I have no idea.
10. Provides basic authority for AX to get involved and delineates specifically what AX should be doing for AFLC and AFSC in this regard.
11. Everything (I wrote it).
12. Nothing
13. Never used it. Didn't read it until a month ago. It told me what things require a waiver and how waivers are processed and that we are not required to employ standard equipment always.

14. Basically our charter in AX.
15. (Not answered)
16. N/A
17. N/A
18. (Not answered)
19. Provides a baseline for new managers/engineers.
20. Good guide.
21. A little familiar with it when it first came out. Doesn't contribute directly.
22. I use it and therefore my people use it.
23. Very little.

28. WHAT DOES THE AVIONICS MASTER PLAN CONTRIBUTE TO YOU AND YOUR WORK WITH AVIONICS STANDARDIZATION?

1. Provides some insight into available technologies to be considered.
2. It means a lot to me - but as a regular engineer I probably wouldn't know about it.
3. Useful for information.
4. Supports avionics conferences, helps to prepare the AMP, and is used by SPOs partly to waiver the use of standardization.
5. None
6. Nothing
7. Don't know what it is.
8. Don't know what it is.
9. I have seen the document but don't work with it.
10. Serves as the information base, identifies standardization needs, helps establish our goals and provides for improving our way of doing business.
11. Shows time, priorities, availability.
12. Nothing.
13. Used as a guide - if it doesn't come to my desk, I won't see it. I became familiar with it while at ENA.
14. Contributes to Air Staff level and industry.
15. (Not answered)
16. Reference document.
17. N/A
18. (Not answered)
19. Source of data
20. Our engineers review the document
21. Have use it frequently to work proposals for a new suite of avionics, e.g. strike system. Gives us an idea of what's coming down the road. I'm probably the only one in the SPO who uses it.
22. I use it and therefore my people use it.
23. Very little.

29. WHAT DOES THE AVIONICS PLANNING BASELINE DOCUMENT

CONTRIBUTE TO YOU AND YOUR WORK WITH AVIONICS STANDARDIZATION?

1. Shows various weapons system configurations in a consolidated report.
2. It means a lot to me - but as a regular engineer I probably wouldn't know about it.
3. Useful for information.
4. Call in AX at this point to get their opinion. The preferred item may include standard items.
5. None
6. Nothing
7. Don't know what it is.
8. Don't know what it is.
9. Never heard of it.
10. Serves as information base on avionics programs (development and modifications). Assists us in analyzing systems.
11. Indicate existing and planned avionics configurations for AF aircraft.
12. Nothing
13. Used as a guide - if it doesn't come to my desk, I won't see it. I became familiar with it while at ENA.
14. Good reference
15. (Not answered)
16. Reference document
17. N/A
18. (Not answered)
19. Planning baseline
20. Nothing now
21. Don't know of it.
22. I use it and therefore my people use it
23. Very little

30. WHAT DOES THE ARMAMENT AND AVIONICS PLANNING GUIDANCE CONTRIBUTE TO YOU AND YOUR WORK WITH AVIONICS STANDARDIZATION?

1. Shows planned efforts to be considered.
2. It means a lot to me - as a regular engineer I probably wouldn't know about it.
3. The output of the guidance conference is really not important. What is important is the interaction among the people involved in working with standardization programs and problems.
4. Supports avionics conferences, helps to prepare the AMP, and is used by SPOs partly to waiver use of standardization.
5. None
6. Nothing
7. Don't know what it is.
8. Don't know what it is.

9. Don't know of it.
10. Coordinated avionics initiatives with users, ALCs, and other commands; provides us insight to focus on key avionics issues.
11. Indicates current issues, possible policy changes, and inputs for the Avionics Master Plan.
12. Nothing
13. Used as a guide - if it doesn't come to my desk, I won't see it. I became familiar with it while at ENA.
14. Helps establish programs.
15. (Not answered)
16. Reference document.
17. N/A
18. (Not answered)
19. Too new to assess. You get what you pay for.
20. Nothing now.
21. Don't know of it.
22. I use it and therefore my people use it.
23. Very little

31. CAN YOU SUGGEST ANY CHANGES TO THE DOCUMENTS IN QUESTIONS 27, 28, 29, AND 30 THAT MIGHT IMPROVE THEIR USEFULNESS?

1. Documents are for informing higher headquarters and are not aimed at tools for architecture avionics systems.
2. More people need to know about these documents to get more use out of them.
3. No
4. These documents are out of date the day they are published. Don't rely too heavily on them - mainly used as a reference.
5. Identify document for use at program office level. Documents listed are primarily for long range planning and are goals which we would like to achieve. My job is to work "now" issues which hopefully will get us to the "then" goal.
6. Don't use them.
7. N/A
8. N/A
9. No
10. I have inputs for updating all of the AX documents on a yearly basis. I feel the documents are improved each year.
11. No
12. No
13. It is difficult to suggest changes.
14. Not really
15. (Not answered)
16. No
17. No

18. (Not answered)
19. No
20. Let's don't create an unnecessary bureaucracy - nobody will look at the documents - personal contact is much more effective.
21. No
22 No
23. The real question is what audience are the documents intended for? They are useful for the staffers in Washington, D.C. but not good for making day-to-day decisions.

32. WHAT PERCENTAGE OF THE TIME DOES YOUR ORGANIZATION SPEND ON STANDARDIZATION ISSUES/PROBLEMS?

a. 0-9
b. 10-15
c. 16-20
d. 21-30
e. 31-49
f. 50 or more

1. b
2. c
3. a
4. b
5. f
6. b
7. a
8. a
9. c
10. f
11. b
12. d
13. a
14. f
15. (Not answered)
16. a
17. a
18. c
19. (Not answered)
20. a
21. a
22. a
23. a

33. DO YOU THINK THE DEPARTMENT OF DEFENSE (DOD) HAS PLACED TOO LITTLE OR TOO MUCH EMPHASIS ON AVIONICS STANDARDIZATION, AND WHY?

1. Standardization is fine if it makes sense to standardize and not standardize without analyzing the effects on cost, schedule, and performance. AX has made the correct emphasis and now it's up to

engineers and program managers to implement the policies.

2. Too little. It's more cost-effective and it is a matter of DOD dollars vs. non-standardized equipment.
3. Too little. It's lipservice and no more unless they come across with the money to fund the standardization programs.
4. They have place a significant amount of emphasis on standardization. The emphasis is wrong - they are not capable enough since the best engineers have been hired away. There are too many green people enforcing standardization.
5. They have supported standardization verbally and in regulations, but their funding lines and program direction does not require standards to be used.
6. About right
7. Not too much - avionics is eating our lunch and the monster must be controlled. The proper approach must be taken to standardize, i.e. don't standardize the black box, but rather lower level modules.
8. Too much has been gold watch (by it's nature very good). No one wants to see that it makes sense. It's a difficult job to build subsystems that fit all aircraft. Frequently we suboptimize, e.g. radio, INS.
9. Too little - people need to be made aware of available standardized equipment.
10. Just about right. However, organizationally wise it is not structured to carry out its initiatives appropriately. DOD lacks technical knowledge of prudent standardization and resources to do the job adequately.
11. Too little. The issues are too hard to work.
12. Just about right - they are doing the right things, just what they should be doing.
13. Too little emphasis in ENA - not enough to standardize components.
14. DOD has strong initiatives but the Air Force is lacking in carrying out those initiatives.
15. (Not answered)
16. Don't know
17. Just about right
18. Too much emphasis. The standard which we used didn't meet it's own specification. The concept of standardization must be readapted to highly integrated aircraft.
19. There is no measure of goodness so emphasis is a moot point. Existing system emphasis flys in the face of competition and low cost.
20. Like any bureaucratic system - there is always over-reaction all too often to allow the

bureaucracy to mask common sense.

21. Too little - if we worked the issues a little harder we wouldn't have problems. There's more of an emphasis on tri-service programs.
22. It's too simplistic. Unless standardization can accomodate technology growth, it may be counterproductive to e mphasize standardization. It's not intrinsically good, it has to be in the right context.
23. Without a good life-cycle cost model, it will always be an emotional answer.

34. WHAT IS YOUR POSITION ON AVIONICS STANDARDIZATION, I.E. FOR OR AGAINST? WHY?

1. For using standards where it makes sense, not standardization for standardization's sake.
2. For. I think it's good for the DOD.
3. For it if it makes sense.
4. For it when it's easy and relatively hard. Against when there aren't rational arguments. Only when it's not preached by a zealot and when it's applicable.
5. Both. Standardization will reduce costs and provide logistics longterm benefits. However, you will pay a price in weapons system performance. You cannot do everything with one item. Selective implementation of standardization must be made.
6. For - under the right circumstances, i.e. reduce cost but not compromise overall weapons system performance.
7. For - reduced system acquisition cost, better competition (and thereby reduced cost), facilitates system upgrades and performance improvement over the life of the system.
8. For it if its properly applied - frequently its not.
9. For - if it's done well and improves logistic support. It is possible to keep up with technology, update, and still be state-of-the-art standardized equipment.
10. For: selective standardization. Why? Smart application reduces ownership cost, reduces schedule risks, and allows P^3I naturally.
11. For, if it makes sense.
12. For it if it is sensible standardization.
13. For standardized functions - the VHSIC is working toward that end because they can be applied across the board. Against if it's at the black box level because of the problems of integration.
14. Yes, its my job.
15. (Not answered)
16. A qualified "for".

17. For it if it makes sense.
18. Against. There is no such thing as a "standard" because of the many changes which occur in the subsystem. We try to simplify things with standardization, but we are dealing with a highly integrated and complex avionics system within the aircraft.
19. For IF it is really cost effective and effective includes resistance to enemy action.
20. I'm for using common sense.
21. For - have to be careful not to drive it against logic - always have to weigh advantages and disadvantages. There are a lot of tradeoffs when considering standardization.
22. (Not answered)
23. If it saves money, and increases effectiveness, I'm for it. If it doesn't, I'm not for it.

35. DO THE PERSONNEL IN YOUR ORGANIZATION SHARE YOUR OPINIONS?

1. Yes
2. Yes
3. Yes, for the most part.
4. Generally, they do.
5. Yes
6. Probably
7. I believe so.
8. Probably so
9. Probably not to the extent it should be - problem lies with mission-related avionics where it is more difficult to standardize.
10. I sure hope so!
11. Yes
12. Sure
13. Yes
14. They better
15. (Not answered)
16. No
17. Yes
18. Yes
19. Yes, standardization is common within the organization - has been since late 70's - routine.
20. Yes
21. Yes, some do and some don't.
22. (Not answered)
23. Some do and some don't.

36. DO YOU THINK AVIONICS STANDARDIZATION HAS BEEN ACCEPTED IN THE ACQUISITION COMMUNITY? WHY OR WHY NOT?

1. Broad standards such as MIL-STD-1553, MIL-STD-1750,

MIL-STD-1760, and MIL-STD-1589 have been accepted.

2. No - they cannot understand the cost effectiveness of standardization for their aircraft vs. the DOD.
3. It is grudgingly accepted. AX never makes a case for standardization, they just want programs standardized.
4. Yes, sometimes it's a struggle, sometimes it's good and sometimes it's bad.
5. No because of the effects of standardization on performance. We in ASD are performance-oriented. Therefore standardization will always be at odds with primary weapon system - unless they are the first one to get it. The second guy is a "bear".
6. By some. Weapons SPOs probably the least. Forcing standardization down people's throats because not enough work is being done up front which causes schedule slips during development.
7. It's becoming more appreciated for its benefits.
8. It has generally been accepted when its not worth fighting for, except on the really big standardization issues.
9. Based on experience it has been reluctantly accepted. AX has to do a lot of selling - then the SPOs will buy. Pressure should be to show why you can't standardize.
10. Partially - "not invented here" syndrome (they don't like using someone else's developed system). The contractor can have a lot of influence over the program manager (a lot of sole source contracts). SPOs lack of prudent business strategy (they accept contractor's word). AFSC vs AFLC (concerns are very different).
11. Yes, because of recent successes (1553, 1589, 1750, 1760, MATE, etc.).
12. It has been accepted because many items have been developed and put into the inventory. Of course, one could argue that there should be more.
13. Not yet- it's easier to find fault than to find a way to make it work. I'm as guilty as everyone else. Integration aspects as opposed to paying the contractor the money to build a new one.
14. No - more due to reason of the lack of understanding and that they don't care.
15. (Not answered).
16. No
17. With the onrush of aeronautics avionics, the decision was made to design them for <u>your</u> system (peculiar). But there has to be a mix of both common and peculiar avionics equipment. When is common better? When is peculiar better? We are more system peculiar than we should be because of the stress on logistics considerations.
18. No, because integration of standardization is too complex because all interfaces aren't defined at

the time a standardization decision is made.

19. Yes. Has been but HQs and OSD fail to recognize broad implementation can increase costs in the short term.
20. Yes. We have accepted standards all along, because it saves money to use standards. The environment is different in each aircraft, something which AX doesn't seem to understand.
21. It has sort of been accepted. Most everyone will standardize if it makes sense without making a big issue out of it.
22. In certain pockets of the community it has been accepted but not promoted because it is alien to the goals of the program manager, i.e. "standardization is great - on your program".
23. Can't argue for or against.

37. WHAT FACTORS HAVE ADVERSELY IMPACTED THE SUCCESS OF AVIONICS STANDARDIZATION?

1. Difficulty in integrating a piece of standard hardware into an avionics system or air vehicles.
2. Lack of capable management at AX.
3. AX has been demanding - they go about it the wrong way. They are not part of the original decision processes.
4. Zealots and persona non grata; more is better.
5. Funding, program direction, command support. Adequate funding has not been programmed which allows transition from AFSC to AFLC control. New weapons systems PMDs do not require use of standard and are worded wishy washy to allow wide interpretation of requirement. Therefore, standardization programs must continually take on the "big boys" to get their program going.
6. Forced implementation on existing systems.
7. The vendor community can protect product lines with unique hardware/software. A new way of doing business must result for the long-term standardization concept.
8. Subsystems are being used as standards - with standardization not developed in mind (after the fact implementation is more difficult and will be fought). Also, don't think AX understands day-to-day problems of a major SPO - communication breakdown. Also, technically very difficult to build a system which will be all things to all people.
9. Perception/opinion that you lose control of the program if you standardize and the fact that AE doesn't get the product in a timely manner.
10. Manpower, funds, lack of direction/policy, and authority vested in standardization organizations.
11. Getting lots of organizations to make compromises.

12. What's made it hard is getting the match from the separately matched trains.
13. Application of standard equipment into a weapon system.
14. High level key decisions based on emotion and not fact.
15. (Not answered)
16. The prevailing system acquisition mindset is adverse.
17. Inadequate information, funds, time and stupidity.
18. Integration of standardization is too complex because all interfaces aren't defined at the time a standardization decision is made.
19. Simple-minded idea that one item fits all and reduces cost on all systems.
20. Going to a certain computer against an unrealistic schedule cost us $40M to the program where we do not plan to use J-73 language.
21. Rapidly expanding technology, zeal of prime to sell technology, and efforts of government to buy the technology.
22. The basic way we do business. Until the program manager is recognized and rewarded for standardizing it won't be easy.
23. Lack of a good life-cycle cost model.

38. WHAT FACTORS HAVE CONTRIBUTED TO THE SUCCESS OF AVIONICS STANDARDIZATION?

1. Standards which reduce cost by easing integration, reducing development time and reducing cost are successful.
2. Personal involvement of a few people.
3. A fair job has been done considering that standardization is not an easy task.
4. It makes a lot of good basic sense. There are opportunities which should be taken advantage of.
5. An aggressive team, and support from the two-letters.
6. Visible opportunities to save dollars and separate staff to review possibilities.
7. Need for integrated avionics systems standards and the "facts of life" with respect to acquisition cost.
8. UHF radio is a success story and the intuitiveness of the fact that standardization makes sense.
9. Perception has changed. Everybody knows that standardization will simplify logistics.
10. Industry's participation, high level standardization advocates (JLC, JSRC, etc), and structured organizational approach.
11. Policy, USAF/RDPV, ASD/AX, lab programs, OSD, and Congressional interest.
12. Hard work, bull-headedness, and continually working the problems of getting the weapons systems SPOs

matched with the standard equipment.

13. Definitely the cost factor (cost savings).
14. Support high level personnel at AFSC and SEC AF, i.e., Gen Slay and Dr. Conen.
15. (Not answered)
16. The urgent need to "do something" to reduce acquisition costs.
17. Realization that system peculiar wasn't the smartest way to go and the success of commercial aircraft avionics standardization. Logistics supportability also.
18. It works in simple systems (A-10, etc).
19. Practical implementation in the development cycle.
20. Common sense and good judgment.
21. 1553, contributions of AX and a desire on the part of the AF managers to keep cost as low as possible.
22. Hard work and dedication of a few people in AX - in spite of built-in headwind.
23. Strong personalities.

39. WHAT CHANGES NEED TO BE MADE TO IMPROVE THE PROCESS OF AVIONICS STANDARDIZATION?

1. Establish a standardization policy which can be utilized rather than try to force pieces of standardized hardware down the throats of people responsible for architecting avionics systems.
2. New capable management - more ASD/AFSC emphasis (don't cut POMs).
3. Recognize that standardization is a continuum and that there are no hard and fast rules for standardizing. AX should operate within the chain of command. AX should also deal in a consensus operation - after the decision is made forget about it and go on to other problems.
4. Pull back and decrease AX's workload. Eliminate duplication and reallocate resources.
5. ASD policy on standards and their use need to be addressed. This policy must be endorsed by prime weapon systems for it to work.
6. Prove and test then bring to program manager early on in the program.
7. Continued commitments to standardize instruction sets, bus architectures, interfaces, languages, et al.
8. Training AX on what a SPO's problems really are. Less emphasis on modification programs and more on new developments.
9. That a major SPO can build something and meet the requirements of standardization, and building avionics doesn't have to be done by AE.
10. Adequate resources (both funds and manpower) and regulation/directives with responsibilities and authorities identified.

11. Just about right.
12. The impediment is the growing number of black programs which prohibit communication to and from the program office and it's tougher to get standard subsystems into deployed aircraft. The contractor must have an incentive to standardize. It's much easier not to standardize.
13. Don't really have an answer.
14. Level of AX needs to be elevated to Air Staff level. We are not the ASD czar for avionics, we are the Air Force.
15. (Not answered)
16. A whole new approach to avionics acquisition.
17. Not close enough to the process at this time to comment.
18. We must take the time to define all interfaces, because F3 doesn't work in a highly integrate, software-intensive system.
19. Need to think out the total acquisition cycle. Impacts to maintenance equipment, depot and system effectiveness - hasn't been done.
20. Move the AX function back into the engineering department along with commensurate authority. Then maybe they'll understand the complexity of standardization.
21. Maybe we shouldn't worry about standardization, just make everybody aware of what's available and hold it up as an item of real importance.
22. Standardize line-replaceable modules.
23. Develop a useful life-cycle cost model.

40. DO YOU THINK THE STANDARDIZATION POLICIES ARE EFFECTIVE? WHY OR WHY NOT?

1. Policies are not effective because they are ambiguous and have no one basic approach.
2. Somewhat - could be better implemented.
3. Not effective mostly because 800-28 can be interpreted to mean different things to different people. Standardization should not be mandated - that's dumb.
4. Yes, they have been effective in achieving the original objectives.
5. No, not without primary weapon system support.
6. Yes, do up front. I'm referring to the ASD supplement to 800-28 which requires AX coordination.
7. Aircraft primes are recognizing their roles - vendors are awakening and progress will come.
8. N/A
9. Can't really say. They are obviously not as effective as they can be. Example is B-1 which built a similar data recorder as ours.
10. Partially, there is a lack of understanding,

authorities are not identified, and 3600 vs 3400 or 1100 monies (color of money - should have a pot of money set aside for standardization programs).

11. Yes, because it's working.
12. (Not answered)
13. No. They are stated, understood, but usually overlooked. Could be a misunderstanding as to why they are overlooked.
14. Partially - difficult to enforce or gain understanding.
15. (Not answered)
16. Don't know
17. They must be effective because AX is a pain in everybody's side.
18. No. They do not solve the problems of integration.
19. Better than nothing. Assumes that standardization is good.
20. They are good enough. We generate a lot of worthless documents. We really should rely more on human factors.
21. Semi- could do a better job.
22. No, because it will either be by edict or by a third party. Each has it's own pitfalls. If there is an edict, the program manager will find a way to get a waiver. If it is through a third party, SPOs will not depend on a third party to hold up their program. Funding might help solve the issues.
23. Regulations are not effective, no matter what they are.

41. WHAT CHANGES NEED TO BE MADE TO THE CURRENT POLICIES/ PROCEDURES TO ENSURE SUCCESS AND MAXIMIZE THE BENEFITS OF AVIONICS STANDARDIZATION?

1. Establish a standardization policy at the physical and interface level and not at the equipment or subsystem level. Some cases of standard modules may be achievable.
2. Need to convince higher authority that standardization is a good thing and is cost effective for some programs.
3. Keep 800-28 because AX won't be given authority and any change could make it worse. People should be reminded of the intent of 800-28. AX is a top-heavy organization - too many chiefs...
4. True measures are needed - when and when not to standardize. A better LCC model and more rational arguments.
5. All PMDs must require standards when it is in the best interest of the Air Force. Trade-offs must be made for weapon system performance if it is to be effective.
6. All standardization is not good - standardization

done at lower levels (piece parts). Ideally, all aircraft should be standardized but that would probably kill the industrial base.

7. Continue as is.
8. Training AX on what a SPOs problems really are and less emphasis on modification programs and more on new developments.
9. You can come up with all kinds of reasons not to standardize and it becomes a self-perpetuating shouting contest. AX needs to push harder for standardization. Instead of AX trying to sell standardization, the SPOs should have to prove why standardizing isn't feasible.
10. Regulations/directives with responsibilities/ authority, standardization monies, and incentives for program managers.
11. Just about right.
12. Standardization initiatives must be transferred from government to industry.
13. Can't answer.
14. Use the requirements as well as the standards. Require avionics czar to sign off on programs.
15. (Not answered)
16. Don't know.
17. Keep on doing what they are doing!
18. F^3 doesn't work in a highly integrated, software-intensive system...you must take the time to define <u>all</u> interfaces.
19. Determine the real goodness of standardization. Use that to evaluate system LCC and concentrate where most needed.
20. None
21. Not familiar with policies and procedures.
22. Grade the program manager on how well he incorporates standardization into his programs.
23. Get a life-cycle cost model and it will be successful.

42. WHICH OF THE FOLLOWING STRATEGIES DO YOU THINK WOULD INCREASE THE LIKELIHOOD THAT A DEVELOPED SUBSYSTEM WILL BE STANDARDIZED?

a. Mandate the use of the subsystem through the contract or through rulings of the Secretary of Defense.

b. Persuade the program manager to accept the subsystem.

c. Provide economic incentives to the contractor to use the developed subsystem.

d. Reduce the level of system optimization and performance extremes (design to cost).

e. Emphasize reliability and maintainability, development cost, and low risk in the system specification.

1. e plus establish standards which are useful and accomplish the overall objectives for standardization.
2. b, d, and e
3. b, d, and e
4. b and c
5. b and c
6. b and e
7. e
8. b
9. a, b, and e
10. c
11. b
12. b and c
13. c
14. c and d
15. (Not answered)
16. c and e
17. b, c, d, and e
18. (Not answered)
19. (Not answered)
20. (Not answered)
21. a, b, d and e
22. c
23. a

43. HOW WOULD YOUR FORCE IMPLEMENTATION OF THE STRATEGIES YOU SELECTED IN QUESTION 42?

1. AX should write policies and procedures for estabishing standard modules and cards (f). Also, (e) is being done by engineers right now.
2. Convince the SPO that it is good for the Air Force or DOD even if it is not as effective for his aircraft.
3. Convince the program manager of (d) and (e).
4. (a) is dumb, (b) can be rationalized with good arguments, (c) will always work if it makes sense, (d) is a false hope and (e) is wishy washy.
5. Put requirements in PMD and strictly enforce waivers applied under 800-28.
6. Force is a bad word. Write the specifications and statements of work (SOWs) instructions as guidelines to help the program manager. Review should be by AX to ensure reasonable applications of the policy. AX should also review the proposals. Source selection process should encourage contractors to standardize if the government writes good requirements.
7. (a) is wrong, (c) impedes progress, (e) will get a better product. AX should review specs to make

sure they are consistent.

8. (a) could do it but not in best interest, (b) is the best- present rational arguments (doesn't normally happen), (c) doubt if there would be enough incentives unless it's in best interest of the contractor, (d) agree if designed to minimum requirements, (e) assumes that standardization improves R&M - doesn't necessarily mean that.
9. Convince the program manager through (e).
10. If the program manager can standardize and use the cost savings somewhere else in his program, he will be more willing to standardize. The same goes for the contractor incentives.
11. Show the program manager the advantages to his program and USAF of the use of standards (primarily interfaces).
12. Don't know but somebody should be working these issues.
13. Program must be set tc where the contractor would have to look at industry-wide applications. It's like the logistics incentive fee where the contractor gets paid for more supportability. In the case of standardization, the contractor could get paid per standardized items.
14. (Not answered)
15. (Not answered)
16. There needs to be a funded program and organization that logically is between the laboratories 6.3A and acquisition SPOs. This organization, perhaps an avionics pre-FSD office would manage integrated avionics functional demonstrations using competition to structure the marketplace supply, but specifying qualitatively the properties desired, such as common modules, fault tolerant architecture, etc. Competitive bids for production cost incentivized contracts would be based upon prior successful functional demonstrations.
17. Shouldn't force implementation. (c) be sure there is no economic incentive for the contractor <u>not</u> to use the standards, and (e) we are doing this one.
18. (Not answered)
19. Question 42 assumes that all standardization is good. There is no data to show that it is.
20. I don't believe in forcing anything - if someone has a proven system the SPOs will be the first to use it.
21. (a) would certainly work through the contract, after you've made a conscious decision that it's the thing to do, verify reliability and that it meets the specification; (b) is weak - would have to understand the requirements, give them a data package with proof of rational standardization; (c) No, it's too difficult to get the prime to agree on what is standard - you would need a

dictionary; (d) mandate as CFE or GFE and relax specification requirements; (e) standard items have low risk because they are already developed.

22. (c) has to be sensible and profitable for both the vendor and the program manager. The vendor must be convinced that it's a good idea to standardize and the program manager must know it's not going to cost him time or a lot of money to standardize.

23. (a) through the contractor mandating is not a good idea. Give the decision-maker the proper tools to evaluate from an AF perspective; (b) program managers come and go - any agreements won't be permanent; (c) hard to see how that happens; (d) absolutely the wrong thing to do; (e) fallacy - avionics standardizaon advocates that because it works good in one plane, it will work good on all aircraft. However the characteristics are different for each aircraft.

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UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

A161709

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): AFIT/GSM/LSY/85S-11	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: School of Systems & Logistics; 6b. OFFICE SYMBOL (If applicable): AFIT/LSY	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State and ZIP Code): Air Force Institute of Technology, Wright-Patterson AFB, Ohio 45433	7b. ADDRESS (City, State and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION; 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State and ZIP Code)	10. SOURCE OF FUNDING NOS. — PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO.
11. TITLE (Include Security Classification): See Box 19	
12. PERSONAL AUTHOR(S): Jennifer A. Furru, Captain, USAF	
13a. TYPE OF REPORT: MS Thesis; 13b. TIME COVERED: FROM _____ TO _____; 14. DATE OF REPORT (Yr., Mo., Day): 1985 September; 15. PAGE COUNT: 125	
16. SUPPLEMENTARY NOTATION	
17. COSATI CODES: FIELD 15, GROUP 05, SUB. GR.	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): Standardization, Avionics, Military Standards, Subsystems, Government Furnished Equipment (GFE)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Title: AVIONICS STANDARDIZATION: PERCEPTIONS AND RECOMMENDATIONS

Thesis Advisor: William A. Dean

Approved for public release: IAW AFR 190-1.
LYNN E. WOLAVER 11 Sept 85
Dean for Research and Professional Development
Air Force Institute of Technology (AFIT)
Wright-Patterson AFB OH 45433

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION: UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL: William A. Dean	22b. TELEPHONE NUMBER (Include Area Code): 513-255-3355; 22c. OFFICE SYMBOL: AFIT/LSY

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

This research effort reflects the perceptions and attitudes about avionics standardization by some members of the acquisition community. All of the interviewees were knowledgeable on the subject of and many had extensive experience with, avionics standardization. They either were currently working or had previously worked with avionics standardization.

The analysis reflects some of the attitudes about the policies amd procedures of avionics standardization and the role of the Deputy for Avionics Control in the process of standardization. The analysis also includes recommended changes to the current process of standardizing avionics equipment.

The result of the research effort shows that the acquisition community has not accepted avionics standardization for a number of reasons. First, the level of assembly at which standardization is required, correlates to its acceptability by the acquisition community. The highest level of standardization, the subsystem level, is the most difficult to accept because of the associated integration problems. On the other hand, the lowest level of standardization, the piece part level, has generally been accepted by everyone. Second, the LCC model currently used by the Deputy for Avionics Control has deficiencies which make it unacceptable, and the model should be revised. Third, the Deputy for Avionics Control has achieved a bad reputation, mostly by their past actions. It's recommended that AX dissolve and become a part of a more respected organization, such as the Deputy for Acquisition Logistics at Wright-Patterson AFB, Ohio. The final recommendations are to give the AX the necessary authority to fulfill their mission and for higher headquarters to strongly endorse the AX's policies and procedures.

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